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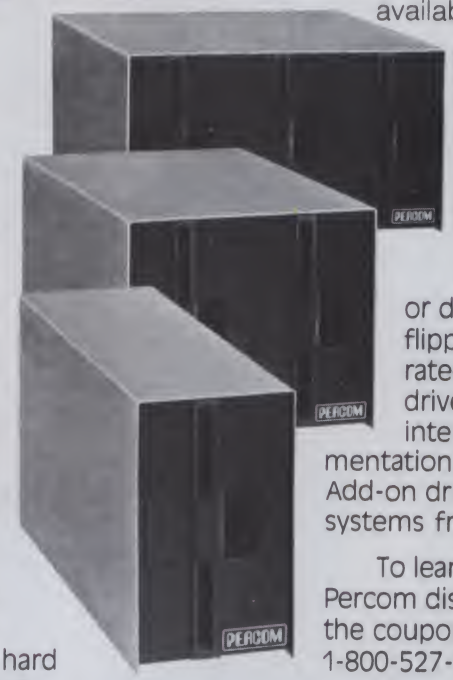
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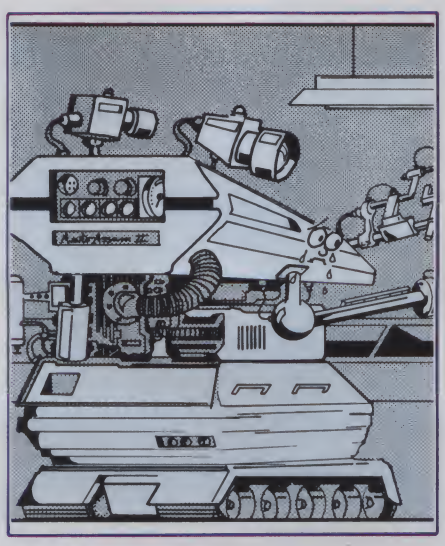
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By Wayne Green

Opportunities Abound

Technology Opens Up New Jobs

Job Security

The government spent I hate to think how much finding out what all of us in the microcomputer field already know: the pay dirt of the future is in computers, and we haven't seen anything yet!

They put computer servicing in the number one spot for growth in need of people. Programmers made sixth place, which shows, I suspect, how much trust we can put in government statistics and surveys. Sure, we *are* going to need a lot of people to service these gadgets, but I believe that the manufacturers will address the lack of service people—and the high cost of using people for service—by designing and building systems that require as little service as possible.

In looking over the Bureau of Labor Statistics' estimate of future job needs, it is obvious that microcomputers were not even considered. Their list has systems analysts in the number three spot. For micros? Unlikely. No, that's inherited from the mini and maxi worlds. They list computer operators in fourth place. Maybe. But don't you think that we are going to come up with some smarter ways of getting stuff put into our computer systems than rows of input operators?

I am going through a crisis in data input with my own typesetting system. It's been difficult for the system to keep up with the growing size of my magazines, the documentation for Instant Software and a burgeoning book department. We've gone from three typesetting systems to five, and now are headed for seven and some sort of high speed new equipment.

Despite the usual insurmountable difficulties, we've managed to interface a microcomputer to the typesetting system and a growing percentage of the keyboarding of type is going this route. This is making it possible for authors to send in their articles on disks. The editors then edit the articles on a compatible machine and feed the finished material into the typesetter.

The pay dirt of the future is in computers, and we haven't seen anything yet!

This interfacing has also opened up the option of letting some of our people type at home on a microcomputer system. Then the disk can be brought in, typesetting codes added, and machine time can be saved.

Well, no matter how you slice it, there are probably going to be more job opportunities in computers over the next ten years or so than in any other field. This means not only that it will be easier to find work, but also that the more industrious career worker will find plenty of golden chances to find the best of work.

We've already seen hundreds of small businesses blossom as a result of the TRS-80. This mini-industry already employs several thousand people. Now we're going to be adding a similar infrastructure supporting the IBM. That's not to short-shrift the Apple support industry, and so on down the line. We may end up with only two or three major firms in the micro systems business, but each of these will be supporting hundreds, possibly thousands, of others. This means plenty of jobs for some time to come.

Further, the proliferation of microcomputers will be triggering a revolution in communications, with large databases developing, electronic mail, satellite communications, direct ordering via computers from stores, and so on. We haven't seen anything yet in hardware, software . . . or career opportunities.

Those Workshops

If your mail is anything like mine it arrives with several invitations for seminars or workshops a week. Obviously, this is a very big business. If only to support the cost of sending out the tons of literature, people must be signing up to take these courses and attend the lectures.

I must admit, perhaps a bit sheepishly, that I've been sucked in a few times. From that admission you can tell, if you're sharp, that there is at least a remote chance that I was somewhat disappointed. I hate to tell you how much time and money I've wasted on seminars that sounded fantastic. I've even managed to make the trip all the way to New York to get conned by some of these things.

It would be simple if *all* of these workshops were turkeys; then I could just put them down as a group and save you a bundle. Unfortunately, in amongst the stiffs are some pretty good information sources, so it comes down to a buyer-beware question. And that's where a magazine such as this can prove worthy of your investment—many times over.

You don't want to miss out on any really good workshops. You also don't want to get suckered into the myriad rip-offs. Now, since I obviously can't go out and check 'em all out for you, what we have here is a failure to communicate between readers. Let's do something about that. If you'll write a review of any workshops or any of the other similar high-cost events, we'll publish the results.

Let us know the who, what, when, where, how much and so forth. Let us know your evaluation of the workshop, pro and con. Is it one you would recommend? If so, for whom? Did you get good value?

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The VCR Debacle

You've probably read about the brouhaha over the use of video recorders. Universal and Walt Disney studios sued Sony because VCR owners might record some of their copyright materials. The court found for Sony. As with all such battles of the titans, the war then moved to the court of appeals, where Mickey Mouse won. Now the case is headed for the Supreme Court, bills are pending in Congress, and one whale of a lot of money is being spent. Wasted.

The VCR people argue that their recorders are being used to enhance the service of broadcasters. By allowing people to watch programs at a time more convenient to themselves, they are increasing the audience of television shows. This time has already been paid for by the sponsors of the shows, so no one is being cheated. None of the recorders I've seen so far has a built-in system for completely eliminating the commercial . . . though this would be nice to have. Even so, it isn't the TV stations who are beefing; it's the movie studios. Do they think we're going to record their damned movies off the air and then sell tickets in our living rooms to neighbors, thus cutting their gate receipts?

One of the great untapped resources in television today is the time shift use of unwanted broadcast hours to provide material of special interest. For a relatively small cost an enterprising firm could buy up the unwanted wee hours and put on material specifically designed to be tape-recorded for more convenient time use. Someone is going to think of this one of these days and make a few million bucks.

I use my VCRs to save time. Not being a fan of commercials, I'm able to cut my viewing time down substantially by recording everything I watch on the commercial channels and viewing it later. I can fast forward through the commercials, running a 30-second spot in about two seconds. Some of the message may be lost on me, but then I am not much of a prospect for a Chrysler, beer, aspirin and most of the other products like that. Wouldn't you like to skip through those 600-600-600-850 headache commercials in two seconds?

Sitcoms can be watched 16 times faster with little loss of anything. A half-hour program can be seen in two minutes, complete with the commercials. There's no sound with this system, but then they didn't spend much on the writing anyway, so no real loss. The average family sits and gawks at television over seven hours per night. With a VCR this whole stint could be compressed to about 28 minutes, including the ball games. You have to be pretty alert to catch some of those important plays at this speed, but you get the hang of it.

They have a gadget on the market which allows you to speed up audio recordings without changing the pitch. The next obvious move is to use this speech sampling system for speeding up the sound as we zip through those slow, boring TV programs. Maybe I'm onto something.

One of the great untapped resources in television today is the time shift use of unwanted broadcast hours

Getting back to VCRs, why spend a whole half hour on Best of the West when you can strip off the introduction, the commercials and the closing format, allowing you to see the entire show in about ten minutes? Found time. Heck, you might even use this extra time profitably by writing some computer programs.

In the meantime I'm not at all happy about Disney running up the cost of VCR machines, our courts and Congress with what I see as a frivolous law suit. I've cancelled all plans to visit Disney World this year and you may be sure that you won't see me in a Disney movie. If Walt were still alive this never would have happened. I'm boycotting Disney and Universal this year, unless their stuff is broadcast on television. I might just tape it then and watch it at my own convenience, out of perversity.

Consumer Electronics Show

A lot of lip service (and media hype) has been devoted to the concept of microcomputers as consumer products. So the obvious show to attend if you want to keep up with the new computer developments should be a consumer electronics show. Well, despite some coverage of new computer products in the past at this biannual extravaganza, the January show this year was a dud.

The main events at the CES shows have been hi-fi, CB, video, calculators, digital watches, portable radios, radar detectors and such. It's been a trade show, with the manufacturers and importers displaying their new products to buyers from department stores, discount chains, hi-fi stores and video stores. Note that I did not include computer stores, Radio Shacks and the usual outlets for microcomputers. That's probably why the computer firms have shied away from this show. Few of the conventional electronic equipment stores have felt equal to coping with computer sales.

The January CES show in Las Vegas always has an impressive attendance, on the order of 50,000. It has the benefit of providing a bit of post-holiday vacation for dealers during the winter, which probably doubles or triples the attendance over what they would have if they ran the show in Kansas City. Not being particularly interested in gambling, I am not a big Vegas fan, but I do enjoy getting to one of their show extravaganzas.

CES was, for the most part, in the doldrums. The poor economy of the country has slowed sales of most electronic gadgets, with the result that research and development has also slowed down. There was little exciting this time. In the computer field HP announced the demise of their "personal computer," the HP-83. TI was pushing kids' toys. The only real news was the new Commodore equipment, starting at $150 on the low end. You'll be reading a lot more about that.

Vegas or no Vegas, that's the last CES show for me for a year or so unless retailing patterns change substantially and more computers start to be sold by discount stores, department stores and so on.

If I were more interested in gambling I would spend a few weeks practicing for it with my computer and I could do reasonably well. Most of you probably know about the ways to beat 21, but shy away because they are fairly complex. It is possible to win rather consistently at craps too, once you know how.

Anyone enjoying the Vegas life could do well settling down there, at least until the casinos get tired of small steady losses. Rooms with a kitchenette are available for around $85 a week in some hotels. All-you-can-eat meals are so cheap it is difficult to believe. How about a $1.99 (plus tax) breakfast with 37 different foods on a buffet? Lunch is $2.49 and dinner $3.49, and that includes all the roast beef and ham you want. The food's good, if you don't mind vying for it with the 400-pound regular customers.

As if all that wonderful food wasn't bad enough, Bob Chang, who runs the tours of the Asian Consumer Electronics Shows in October, had a special Chinese dinner for his regulars. This year's tour, by the way, will not only include the shows in Japan, Taiwan, Hong Kong and Beijing, but will continue around the world for those interested, to Munich and London. The price is right. The Asian shows, by the way, are a gold mine for anyone interested in importing electronic gadgets. They also do a lot better as far as microcomputers are concerned than CES.

Sherry and I have been on the Asian tour twice now and found it to be first rate. You stay at top hotels and get more meals thrust at you than you can handle. The electronic shows are big and exciting. They give you a chance to meet manufacturers you'd never get to see any other way. The inclusion of China in the trip this year is a plus. In 1980 a group of us made a side trip to China, but it wasn't at that time a regular part of the tour.

If I can get things caught up enough,

we'll be on the trip again this year.

Another Trauma for Green

Just what I needed, another record format. Truthfully, I'm still sulking over the change from 78 to 33 rpm records. That painful technological change hit me 30 years ago and left a permanent mark. I still have perhaps a 30-foot shelf of 78s up in the attic, just in case they make a comeback.

The last improvement gave me about five times as much music per disk, plus some weight loss per disk, though the diameter stayed the same at 12 inches. The cost per piece of music went down substantially. A ten record album in the 40s cost $10, which is about equivalent in today's dollarettes to $175. The same music today takes two records at about $15 or so. Not bad. The quality is marginally better too, and the records don't break now.

Still, here I am with a nice library of LPs—about 18 feet of them. That's close to 1000 disks. Even if they get a lot more music on the 4½ inch digital disks, I'm still faced with a crushing cost to convert my software to the new format.

One thing is for sure—a major change in format such as that announced by Toshiba (see photo) can only hurt the existing market for record players.

With the digital laser beam reading records on the horizon, you have to have some serious emotional problems to go out and make a $1000 or more commitment to a dying technology.

Well, here we go again. Fortunately, I have room in the attic for my old LPs too. The bright side of this is that at my age this will undoubtedly be the last change I have to face in record formats. □



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By Robert W. Baker

VIC Disk Is Here

Initial Tests Favorable

VIC-1540 Disk

In January I received a VIC-1540 disk as a beta test site. The enclosure is white plastic and styled similar to the VIC. The disk format is identical to that used in the current CBM 4040 disk, and diskettes are completely interchangeable between units.

I encountered no major problems with the disk operating system (DOS) or operation of the disk, so production models should be available by now. The original documentation was extensive but contained a number of errors. Most of the utility programs supplied on the Test/Demo disk needed further work as well. Hopefully these will be cleaned up before being distributed.

Saving and loading programs on the disk is easy—just add a comma followed by the number 8 at the end of the Save or Load command. However, if you want to rename or delete a file on the disk it gets a little more involved. Any command that you want the DOS to execute must be sent through a command channel to the disk. You have to open the command channel and then use a Print# command to pass disk commands to the DOS. The VIC operating system doesn't include disk commands like the latest PET/CBM systems. This should sound very familiar to 2040 disk owners!

Unfortunately, Commodore didn't create a DOS support program, like the DOS Wedge, for the VIC. Instead, a simple Basic program that provides an easy way to display the disk directory, execute disk commands or check the disk status is included with the VIC-1540 disk. Remember though, since this is a Basic program, there are times when you cannot use it and must know how to use the command channel. If you get an error when trying to save a program on disk, there is no easy way to read the disk status. You have to type in a few program lines and run them to read the disk status. The Input# command needed to read the disk status cannot be performed in immediate mode from the keyboard.

Apparently, Commodore has taken the same path with the VIC disk as with the original PET 2040 disk. Many people were upset once they found out how clumsy it was to use the original 2040 disk. Once the DOS Wedge was generated, things did get a little better. Unfortunately, we're right back where we started until someone can come up with a DOS Wedge or similar help for the VIC disk.

The preliminary Test/Demo disk did not include any backup utilities. The only way to back up a program is to load it into memory, switch disks, then save the program on the backup disk. At present, there is no way to copy a sequential data file from one disk to another. Unless you have a friend or local dealer with a 4040 disk, there's no way to back up these files.

Input Bug

Recently I found a serious bug in the original VIC operating system software. I've made Commodore aware of the problem and they plan to correct it as soon as possible. The problem appears whenever you print a prompt for an input command and the prompt is longer than 22 characters, causing the display line to wrap. Whenever the prompt causes a line wrap, the prompt is returned along with any characters that are entered from the keyboard.

If the program is expecting a string response to an input command with a string variable (A$), you simply get the wrong response. The response the program sees in the string variable will contain the entire input prompt plus the characters entered from the keyboard.

When the program is expecting a numeric response to an input command with a floating point (B) or integer (C%) variable, then you really have a problem. Again, the entire input prompt is returned along with the user response from the keyboard. Since the prompt will generally be an alphanumeric string, the program will display a REDO FROM START error message, re-display the input prompt and wait for another input response. No matter what you enter from the keyboard, the program will always see the prompt text first and complain about getting the wrong type of response.

The problem is even worse once you remember a new VIC feature. If you hit the return key without entering any characters first, the system returns the last keyboard response entered on the VIC. On any PET or CBM system this would terminate execution of the Basic program and READY would be displayed. You cannot hit the return key alone to get out of the error condition caused by the input error on the VIC. I have found, however, that sometimes you can hit a shifted-return followed by a normal return to get out of a crazy state like this.

So, if you've displayed an input prompt that causes the line to wrap and you're trying to get a numeric input, you've probably hung the VIC system and may have to turn it off. Any keyboard input simply returns the REDO FROM START error message and re-displays the long prompt that caused the whole mess. Hitting return re-enters the last keyboard input, causing the same results. Even the run/stop key cannot always get you out of the error condition since the program is not really executing any Basic statements. You might be able to enter a shifted return followed by a normal return and recover. Otherwise, the last resort is to turn off the VIC and start over.

If you try this simple little test program, you'll quickly see what is happening if the problem exists on your VIC:

```
10 INPUT"PLEASE ENTER ANY TEXT
RESPONSE";A$
20 PRINT A$
```

Address correspondence to Robert W. Baker, 15 Windsor Drive, Atco, NJ 08004.

When you run this program, the prompt is displayed and wraps the line. Enter any text followed by return. The program will display the value it received for A$. If the problem exists on your VIC, the entire prompt will reappear followed by your keyboard entry. By typing PRINT A$ as an immediate command, you can prove to yourself that the A$ response is really as shown.

Now change A$ in both lines to A and run the program again. This time you'll see the REDO FROM START error, even if you enter a valid numeric response. Try hitting the return key. Still getting the error? How about the run/stop key. Can you get out of the error condition? OK, try hitting the return key while holding the shift button. Now hit return again without the shift. This may get you out of the error condition. If you're not having any luck, turn off the VIC and start over.

This same problem occurs if you use a Print command for the prompt and an Input command to get the response. This program causes the same problems:

```
10 PRINT"PLEASE ENTER ANY TEST RESPONSE":
20 INPUT A$
30 PRINT A$
```

So far I haven't found a cure for the problem, so watch the length of your input prompts until Commodore comes up with a fix.

By the way, if you enter enough characters in response to an input prompt to wrap a line on an 8032/8016 system, only the characters on the last line when return is hit will be returned in the program variable. Remember that the 80-column systems do not support line wrapping like the 40-column machines and the VIC. If the input prompt wraps a line, it has no effect on the input characters other than limiting the number of characters that can still fit on that line.

Basic Aid

F. Arthur Cochrane, of Beech Island, SC, has created new and improved versions of several utility programs that have been around for some time in the public domain. In particular, he has created new versions of Basic Aid and Micromon and has put together an extension to the Power ROM. Since many people have been trying to locate copies of these programs for their systems, I thought it may be of interest to show you what Arthur has done with them. These new versions are all being made available on disk through one of the user groups, ATUG, which I'll mention more about later.

Basic Aid is a machine-language utility program for the PET/CBM that loads into upper RAM and adds a number of commands to the Basic operating system. Earlier versions contained commands for auto line numbering when entering new programs, block deletes, line renumbering, repeating keys, program tracing, etc. Since Basic Aid uses many of the ROM routines, there are specific versions for each machine and ROM set.

Cochrane has created a new and improved version, adding a number of new commands and features, including screen print, true program merge, print spooling, scrolling and other fancy and useful features.

He has created copies of his new Basic Aid for most Commodore machines; including Basic 3.0 and 4.0 ROMs; 40, Fat-40(40-column machines with 12-inch screens), or 80-column displays; and Commodore or ASCII printers (in all logical combinations). Each copy automatically relocates itself to the top of RAM, so it will work in both 16K and 32K machines. Eight different copies are available on one disk through the ATUG Disk Exchange for less than $10—but more about that later. By the way, the disk also includes the source code for Eastern House Software's MAE assembler and instructions that you can print using Word Pro. The instructions were generated using Word Pro 3 + but can be printed using Word Pro 3 or 4 with a few slight changes.

Since many people haven't seen Basic Aid I thought it might be worthwhile to include a list of its commands and a brief description of each:

- *Auto*: prints incrementing Basic line numbers for you as you key-in a program.
- *Break*: calls the machine-language monitor.
- *Change*: searches through a Basic pro-

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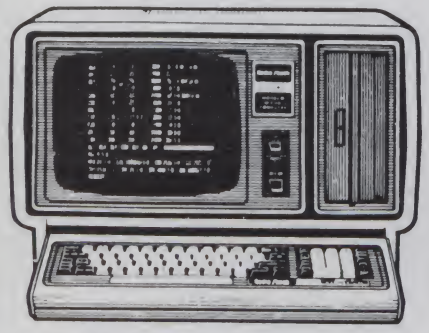
gram in memory for a specified string and replaces it with another string given in the command. You can specify a range of lines or search and change an entire program.

- *CRT*: the current contents of the display screen are sent to a printer connected to the IEEE bus as device number 4. Different versions support ASCII or Commodore printers.
- *Delete*: deletes a given range of lines from a Basic program.
- *Dump*: lists the variables used in a Basic program and their current values in the order in which they were created. They are printed in such a way that you can edit the values and then continue execution with the updated values. Arrays are not included in the listing.
- *Find*: searches a Basic program for a string and displays the lines where it occurs. A line range can be specified or the entire program can be searched.
- *FList*: lists a Basic program from a disk file directly to the screen without affecting the contents in memory.
- *Help*: displays the Basic line where an error occurred during program execution causing the program to stop. The part of the line causing the problem will be highlighted.
- *Kill*: disables Basic Aid.
- *Lower*: puts the system in lowercase mode, same as a Poke 59468,14.
- *Merge*: merges a Basic program on disk with the one in memory. This is a true merge just as if the lines were typed in from the keyboard. Lines are merged between ones in memory if necessary, and duplicate lines in memory are replaced with the merged lines. The program is listed as it is being merged.
- *Off*: cancels repeat keys (except on Fat-40 and 8032 systems), scrolling, and keyprint features.
- *Pack*: removes remarks and wasted spaces in a Basic program currently in memory. The documentation admits that this feature can be easily fooled and recommends saving a copy of the program before performing this function.
- *Read*: reads a sequential file from the disk and displays it on the screen.
- *Renumber*: renumbers a Basic program correcting all GOTOs and GOSUBs. Specific starting and increment numbers can be specified.
- *Repeat/Scroll*: enables repeat keys, scrolling and keyprint. Repeat keys are set automatically when Basic Aid is first called, and automatically cancelled each time a program is loaded.

The keyprint function lets you send the screen contents to the printer with the press of one key. This is the same as the CRT command except that it can occur in a program. This is useful for printing instructions from a program that will normally only display them on the screen.

The cursor up and cursor down control keys can be used to scroll through a Basic program listing. When the cursor is at the bottom of the screen and a cursor down is pressed, the next line will be printed. When the cursor is at the top of the screen and a cursor up is pressed, the previous line is listed. The cursor must be in the first two columns for scrolling to occur.

- *Size*: gives the size of a Basic program in memory or any program on disk. The size is displayed in both decimal and hexadecimal.
- *Spool*: sends a file directly from the disk to the printer. The system can then do other things, such as editing a program, as long as the IEEE bus is not accessed. The command is started with the command and a filename of a sequential file. Basic Aid opens the file and "listens" the printer, then gets off the IEEE bus. This allows the disk to "talk" directly to the printer. When the printer stops printing, just enter the command again without a filename to "unlisten" the printer, "untalk" the disk and close the file. The spool command can be used to list a long program while you use the system for something else, if you save the listing in a sequential disk file first.



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- *Start*: gives the load address of a program on disk in decimal and hexadecimal.
- *Trace*: enables or disables the tracing of a Basic program. Tracing takes place in a window in the upper right of the screen. The last nine lines plus the current line are displayed. Both the line number and what is executing in the line are listed. A command option controls the speed of the tracing.
- *Un-new*: recovers a Basic program after a New command is entered.
- *Upper*: puts the system into uppercase mode the same as entering a Poke 59468,12 command.
- *DOS Support*: includes all DOS Wedge commands and features.

As you can see, there are a number of useful features packed into this utility. By the way, the commands that print to the screen can be paused, held or stopped, and the escape mode feature of the 8032/8016 is also implemented.

Micromon

Micromon itself started as Extramon, which is an extended monitor for the PET, originally written by Bill Seiler. The original Micromon was an improved version of Extramon, also written by Bill Seiler. It has the same commands as Extramon, plus those of the TIM monitor. If you do any work in machine-language programming on the PET/CBM, you'll probably want a copy of Extramon or Micromon. They add a number of features badly missing in the standard Commodore (TIM) monitor.

Now Cochrane has further improved Micromon with the addition of 11 new commands. It also has repeats on all keys and you can use the cursor up/down keys to scroll through memory dumps and disassembler listings. A quick list of the commands of this latest Micromon is shown in Table 1 so you can see some of its powerful debugging aids.

There are several extended monitors available for the PET/CBM, many with similar features. Earlier monitors only worked on one particular machine due to their dependence on ROM routines. This latest Micromon will work on Basic 3.0 or 4.0 machines without modification. If you like, Micromon can even be assembled and burned into an EPROM, then plugged into an empty PROM socket of the PET/CBM. Once you do this, Micromon is always available—just enter a SYS command whenever you need it. You no longer have to load it each time the system is reset or powered up.

A copy of the Micromon source code (in MAE assembler format), as well as the actual program and Word Pro documentation, are available on disk through ATUG. A copy of Extramon 9.3 is also available along with a Basic program that provides instructions on its use.

A = A simple one-line assembler.
B = Set a break point.
C = Compare two ranges of memory and print any differences.
D = Disassemble a range of memory.
E = Exit Micromon.
F = Fill a range of memory with a specified value.
G = Go to the address specified and begin program execution.
H = Hunt a range of memory for a certain pattern.
K = Kill Micromon and restore interrupt vectors.
L = Load a program from disk.
M = Display a range of memory in hex and ASCII.
N = Relocate a machine-language program to a new area of memory by fixing three-byte instructions or two-byte constants.
O = Calculate branch instruction offsets.
Q = Quick trace of program execution.
R = Display the register values when Micromon was entered. The values can be changed using the screen editor.
S = Save a range of memory in a disk program file.
T = Transfer a range of memory from one location to another.
W = Single step program execution.
X = Exit to Basic.
Z = Change character sets.
.$ = Convert a hexadecimal number to decimal, ASCII and binary.
.# = Convert a decimal number to hexadecimal, ASCII, and binary.
.% = Convert a binary number to hexadecimal, ASCII, and decimal.
." = Convert an ASCII character to hexadecimal, decimal and binary.
.+ = Add two hexadecimal numbers and display the sum.
.– = Subtract two hexadecimal numbers and display the difference.
.& = Compute the checksum for the range of memory indicated.

Table 1. Micromon commands.

ATUG

For those unfamiliar with ATUG, this is the ASM/TED User Group that offers a program exchange for those using Eastern House Software's various assemblers. They now have over ten different 4040 disks full of various programs that you can get at reasonable cost. If you supply the disks, with return postage and a self-addressed mailer, the cost is $5 per disk. Otherwise, send $10 per disk and the User Group will supply everything. By the time this appears, 8050 disks should also be available.

The various programs by F. Arthur Cochrane mentioned here are available through the ATUG program exchange. All of the programs are available on one

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single 8050 disk along with a few other miscellaneous programs. If you need a 4040 format disk, Basic Aid is on one disk while Extramon and Micromon are on another.

At present, requests for 4040 disks should be addressed to Brent Anderson, 200 S. Century, Rantoul, IL 61866. Anyone needing 8050 format disks can send their requests to me at 15 Windsor Drive, Atco, NJ 08004. Since I'll be helping with the distribution of disks, I'll try to provide more information on the other disks available through the program exchange in a later column. If you've been receiving copies of the Midnight Gazette, you should see occasional reports from the program exchange there.

For anyone who hasn't heard about the Midnight Gazette, this is a free newsletter containing reviews and the latest information on Commodore-related items. It is published quarterly by the Central Illinois Pet User Group. To get future issues, send up to four double-stamped self-addressed envelopes or U.S. funds for same. Send your requests to CIPUG, 635 Maple, Mt. Zion, IL 62549.

While on the subject of newsletters, The Paper is still in publication as an exclusive newsletter for Commodore-related topics. It is now being published six times a year by Centerbrook Software Designs, Pearl Street, Livingston Manor, NY 12758. Cost is $4 per copy or $20 for all issues of the current volume. Canadian subscriptions are $25/volume while foreign subscriptions are $30 (surface) and $40 (airmail) per volume. This is an excellent newsletter, typically running over 50 pages in length. They desperately need new subscribers to stay alive. Drop them a line if you'd like to see something like this continue.

Word Pro Quit

Jim Halsey, of Execom Corp., has come up with a nice little modification for Word Pro 3 that lets you quit or exit Word Pro gracefully without powering down or resetting the system. Evidently this process was thought of at the time Word Pro was written, but some of the needed code is missing. Halsey's changes take advantage of 88 bytes of extra memory that exist on his Execom-80 board. However, you could rewrite the changes to use EPROM storage or any other RAM expansion memory that will not be used by Word Pro. I've included Halsey's changes for Basic 3.0 (Table 2) and 4.0 (Table 3) since you may still be able to use them even if you don't have the Execom board. A disassembly listing is included along with memory dumps for both versions.

To make changes to Word Pro, first load Word Pro into memory without using the auto-start load commands. This puts the program into memory and allows you to make the changes using the monitor. Then simply save the new version onto disk and give it a try. To be safe, use a different filename and don't delete your original Word Pro program. If you've made a mistake you can start over again!

After loading Word Pro, get into the monitor and display locations 38BF to 38C2 (hexadecimal). They should originally contain the hex values of C9 43 F0 44. If your version of Word Pro 3 doesn't contain these values, then you cannot make the changes shown. If the values are OK, then make the required changes for your Basic version.

Display locations 0362 to 03B9 and enter the new hex values shown using the screen editor and the monitor. Now check locations 0410 to 0412; they should originally be 4C D7 14. Change the D7 to 62 and the 14 to 03. This makes the program execute the subroutine you just entered from 0362 to 03B9. Don't forget to save a copy of the new Word Pro version back onto disk. Once you've made all the changes, you simply enter a control-O followed by Q to exit from Word Pro. Actually, the control key is the off rvs key on the Commodore keyboard.

If you find that you're not quite sure how these changes are to be made, or you have a different Word Pro 3, you can send your original Word Pro 3 disk to Execom and they'll make the changes for a $5 handling fee. Their address is Execom Corp., 1901 Polaris Ave., Racine, WI 53404. Remember that this change can only be used with their Execom-80 board as it is now written!□

```
.; 0362 A9 FF    LDA #$FF
.; 0364 8D FF 87 STA $87FF
.; 0367 20 29 E2 JSR $E229
.; 036A A0 00    LDY #$00
.; 036C B9 85 03 LDA $0385,Y
.; 036F 99 00 84 STA $8400,Y
.; 0372 C8       INY
.; 0373 C0 30    CPY #$30
.; 0375 D0 F5    BNE $036C
.; 0377 B9 85 03 LDA $0385,Y
.; 037A 99 8F 38 STA $388F,Y
.; 037D C8       INY
.; 037E C0 34    CPY #$34
.; 0380 D0 F5    BNE $0377
.; 0382 4C D7 14 JMP $14D7
.; 0385 C9 51    CMP #$51
.; 0387 F0 08    BEQ $0391
.; 0389 C9 43    CMP #$43
.; 038B F0 01    BEQ $038E
.; 038D 60       RTS
.; 038E 4C 07 39 JMP $3907
.; 0391 A9 89    LDA #$89
.; 0393 8D 94 00 STA $0094
.; 0396 A9 C3    LDA #$C3
.; 0398 8D 95 00 STA $0095
.; 039B A9 17    LDA #$17
.; 039D 8D 92 00 STA $0092
.; 03A0 A9 FD    LDA #$FD
.; 03A2 8D 93 00 STA $0093
.; 03A5 A9 2E    LDA #$2E
.; 03A7 8D 90 00 STA $0090
.; 03AA A9 E6    LDA #$E6
.; 03AC 8D 91 00 STA $0091
.; 03AF 20 29 E2 JSR $E229
.; 03B2 4C 16 E1 JMP $E116
.; 03B5 20 00 84 JSR $8400
.; 03B8 EA       NOP

.; 0410 4C D7 14 JMP $14D7


.: 0362 A9 FF 8D FF 87 20 29 E2
.: 036A A0 00 B9 85 03 99 00 84
.: 0372 C8 C0 30 D0 F5 B9 85 03
.: 037A 99 8F 38 C8 C0 34 D0 F5
.: 0382 4C D7 14 C9 51 F0 08 C9
.: 038A 43 F0 01 60 4C 07 39 A9
.: 0392 89 8D 94 00 A9 C3 8D 95
.: 039A 00 A9 17 8D 92 00 A9 FD
.: 03A2 8D 93 00 A9 2E 8D 90 00
.: 03AA A9 E6 8D 91 00 20 29 E2
.: 03B2 4C 16 E1 20 00 84 EA 00


.: 0410 4C D7 14 AA AA AA AA AA
```

Table 2. Word Pro 3 modification for Basic 3.0.

```
.; 0362 A9 FF    LDA #$FF
.; 0364 8D FF 87 STA $87FF
.; 0367 20 4B E0 JSR $E04B
.; 036A A0 00    LDY #$00
.; 036C B9 85 03 LDA $0385,Y
.; 036F 99 00 84 STA $8400,Y
.; 0372 C8       INY
.; 0373 C0 30    CPY #$30
.; 0375 D0 F5    BNE $036C
.; 0377 B9 85 03 LDA $0385,Y
.; 037A 99 8F 38 STA $388F,Y
.; 037D C8       INY
.; 037E C0 34    CPY #$34
.; 0380 D0 F5    BNE $0377
.; 0382 4C D7 14 JMP $14D7
.; 0385 C9 51    CMP #$51
.; 0387 F0 08    BEQ $0391
.; 0389 C9 43    CMP #$43
.; 038B F0 01    BEQ $038E
.; 038D 60       RTS
.; 038E 4C 07 39 JMP $3907
.; 0391 A9 FF    LDA #$FF
.; 0393 8D 94 00 STA $0094
.; 0396 A9 B3    LDA #$B3
.; 0398 8D 95 00 STA $0095
.; 039B A9 78    LDA #$78
.; 039D 8D 92 00 STA $0092
.; 03A0 A9 D4    LDA #$D4
.; 03A2 8D 93 00 STA $0093
.; 03A5 A9 55    LDA #$55
.; 03A7 8D 90 00 STA $0090
.; 03AA A9 E4    LDA #$E4
.; 03AC 8D 91 00 STA $0091
.; 03AF 20 4B E0 JSR $E04B
.; 03B2 4C B6 D3 JMP $D3B6
.; 03B5 20 00 84 JSR $8400
.; 03B8 EA       NOP

.; 0410 4C D7 14 JMP $14D7


.: 0362 A9 FF 8D FF 87 20 4B E0
.: 036A A0 00 B9 85 03 99 00 84
.: 0372 C8 C0 30 D0 F5 B9 85 03
.: 037A 99 8F 38 C8 C0 34 D0 F5
.: 0382 4C D7 14 C9 51 F0 08 C9
.: 038A 43 F0 01 60 4C 07 39 A9
.: 0392 FF 8D 94 00 A9 B3 8D 95
.: 039A 00 A9 78 8D 92 00 A9 D4
.: 03A2 8D 93 00 A9 55 8D 90 00
.: 03AA A9 E4 8D 91 00 20 4B E0
.: 03B2 4C B6 D3 20 00 84 EA 00


.: 0410 4C D7 14 AA AA AA AA AA
```

Table 3. Word Pro 3 modification for Basic 4.0.

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Word processing that goes beyond the stars.

How could anyone call their word processor The FinalWord? Take the best features of the most popular word processors, combine them and add a few more in one text editor/formatter and you'd be off to a good start. Then, write the program in C to allow user customization and make it capable of supporting any printer on the market and you'd be ahead of everybody else. If you went one step further and made your word processor transportable from one terminal to another you'd have—The FinalWord.



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Features that go beyond the stars: Look at what you get with The FinalWord: automatic generation of Table of Contents, Index, footnoting and chapter/section numbering; enhanced command sets (delete/move a letter, word, sentence, paragraph, page); multiple buffers and windows, deletion recovery, true proportional spacing and more. And because we wrote The FinalWord to be easily reconfigured for different systems, our price can be lower.

Features	The FinalWord	WordStar	Magic Wand
Full-Screen Editing	Yes	Yes	Yes
Directory Access while Editing	Yes	Yes	Yes
Simultaneous Printing while Editing	Yes	Yes	Yes
External Commands while Editing	Yes	Yes	No
Video Highlighting	Yes	Yes	No
Automatic Footnotes	Yes	No	No
User-Defined Commands	Yes	No	No
Multiple File Editing	Yes	No	No
Deletion Recovery	Yes	No	No
Supports Multiple Printers	Yes	No	No
Crash Recovery	Yes	No	No
Dynamic Include Files	Yes	No	Yes
Suggested Retail Price	**$300**	**$495**	**$395**

The FinalWord requires a 56K CP/M system and video terminal with cursor positioning character sequences. It is presently available in 8" standard format for the TRS-80 Model II, Vector Graphics and Altos Systems. There are compatible versions for the HP-125, Xerox 820, Cromemco, Micropolis, Ohio Scientific and Dynabyte Systems, and there are 5¼" versions for the Heath/Zenith Z-89, Northstar, Apple and Superbrain. **Coming Soon: The FinalWord for the IBM Personal Computer.**

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↙See List of Advertisers on page 178

By Frank J. Derfler, Jr.

Direct From DataSpeak

Kesa Company's Inexpensive New Modem

Welcome to Dial-up Directory. This month, we'll review a new modem, examine the alternative telephone service available from Western Union, and look again at the impact of deregulation on your telephone service. But first, an announcement and a few views from the mailbag.

Mailbag

Jim Preston sent me a nice note on CompuServe pointing out that the non-prime rate for the Dow Jones Information Service (January Dial-up Directory) now starts at 6:01 PM and ends at 4:00 AM EST. Jim also points out that although the per-minute rate is higher on DJIS, there are no extra charges as there are on CompuServe, so the net difference is not as great as it might seem.

Modem 80 Revisited

Leslie Mikesell, the author of Modem 80, which we reviewed last month, has asked me to re-emphasize that Modem 80 is a program for the TRS-80 Model I and III that runs under TRSDOS. It allows the transfer of files with CP/M systems running the CP/M program called Modem, but it is not a CP/M program. The review was quite clear in explaining this, but many readers apparently did not catch the difference.

The IBM PC

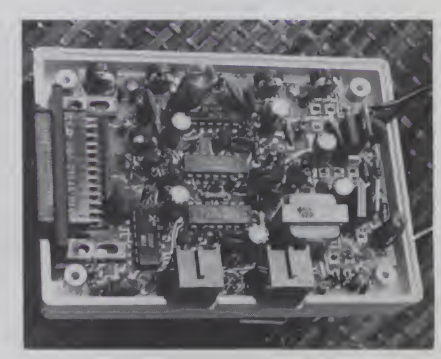
I've been receiving a lot of mail asking about data communications software and bus decoding modems for the IBM PC. If you are marketing or developing hardware or software for this system, please let me know. The world is holding its breath.

DataSpeak

Here is a nice little modem, which operates well and provides good value. The DataSpeak O/A-300 modem is manufactured and distributed by the Kesa Company in Sunnyvale, CA. At $129 it's the least expensive direct connection modem I've seen that still meets the FCC requirements.

Before we get too far along, let's review what "direct connection" means. The term "direct connection" indicates that the device connects directly to the telephone line and that it does not use acoustic or inductive coupling. The main advantage of direct connection is a reduction in the amount of noise that can potentially enter and disrupt a circuit and elimination of troublesome distortion and harmonics from the telephone instrument. The disadvantage of direct connection is the need for modular plugs on the telephone or telephone line to allow the electrical connection.





The Kesa DataSpeak model O/A-300 is a compact, American made, direct connection modem available for $129. The modem is based on a phase lock loop. It includes an audio feedback circuit which loops the transmitted signal back to the receive port for testing of the internal modem circuitry, interface hardware and terminal software.

A direct connection modem should not be confused with a bus decoding modem like the Lynx, Microconnection, Hayes Micromodem or PMMI. These devices happen to also be direct connection modems because they plug directly into the telephone line but not all direct connection modems plug into the computer data bus. The DataSpeak modem plugs directly into the phone line, but it needs an RS-232-C serial port to interface with a microcomputer or terminal.

The DataSpeak O/A-300 is small, attractive, and easy to operate. It measures only 4.5 × 3.5 × 1.5 inches. The modem will operate in the originate or the answer mode. The device is designed to go in series with a standard telephone. The use of a series connection means you don't have to buy an additional parallel telephone jack or cord as you do with many more expensive direct connection modems. The off-hook LED gives you a positive indication of when the modem has control of the phone line. This again is an improvement over some direct connection devices that can hold up the phone line for hours if the operator doesn't notice the position of the switch. A test switch is included which loops back the modem tones to allow local testing of computer communications software, the RS-232C interface and the modem itself.

The DataSpeak comes with a 17-page manual, which fully describes the connection and operation of the device. The manual isn't fancy and it would benefit from an index, but it is complete.

The DataSpeak O/A-300 is a good value. It provides reliable operation at a very reasonable price. It is available for $129 (plus $3 shipping) from the Kesa Company, 774 San Miguel Ave., Sunnyvale, CA 94086 (408-746-2738).

Western Union Metro I

In the November 1981 Letters to the

NEW! TPM* for TRS-80 Model II
NEW! System/6 Package
Computer Design Labs

Z80* Disk Software

We have acquired the rights to all TDL software (& hardware). TDL software has long had the reputation of being the best in the industry. Computer Design Labs will continue to maintain, evolve and add to this superior line of quality software.
— Carl Galletti and Roger Amidon, owners.

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All of the software below is available on any of the following media for operation with a Z80 CPU using the CP/M* or similar type disk operating system (such as our own TPM*).

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BASIC II

Basic I but with 12 digit precision to make its power available to the business world with only a slight sacrifice in speed. Still runs faster than most other Basics (even those with much less precision). $99.95/$15.

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ZEDIT

A character oriented text editor with 26 commands and "macro" capability for stringing multiple commands together. Included are a complete array of character move, add, delete, and display function. $49.95./$15.

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MACRO I

A macro assembler which will generate relocateable or absolute code for the 8080 or Z80 using standard Intel mnemonics plus TDL/Z80 extensions. Functions include 14 conditionals, 16 listing controls, 54 pseudo-ops, 11 arithmetic/logical operations, local and global symbols, chaining files, linking capability with optional linker, and recursive/reiterative macros. This assembler is so powerful you'll think it is doing all the work for you. It actually makes assembly language programming much less of an effort and more creative. $79.95/$20.

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Expands upon Macro I's linking capability (which is useful but somewhat limited) thereby being able to take full advantage of the optional Linker. Also a time and date function has been added and the listing capability improved. $99.95/$25.

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This is an expanded debugger which has all of the features of Debug I plus many more. You can "trap" (i.e. trace a program until a set of register, flag, and/or memory conditions occur). Also, instructions may be entered and executed immediately. This makes it easy to learn new instructions by examining registers/memory before and after. And a RADIX function allows changing between ASCII, binary, decimal, hex, octal, signed decimal, or split octal. All these features and more add up to give you a very powerful development tool. Both Debug I and II must run on a Z80 but will debug both Z80 and 8080 code. $99.95/$20.

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TPM*

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Editor column, *Microcomputing* published a letter from Joseph E. Lopez of the Western Union Company. Mr. Lopez wrote to remind us that his company markets an alternative telephone service called Metro I. Metro I is one of the alternatives to the more traditional telephone companies. Other alternative services such as those from SP Communications and MCI have been described in this column. I apologize to Western Union for not mentioning their service, but I was under the impression that it was aimed at large-volume commercial users, not typical *Microcomputing* readers.

As this issue is being put to bed, the lawyers are still struggling to see if the U.S. Government's suit against AT&T will be settled or prosecuted further. Regardless of the immediate decision, it is clear that the telephone system of the United States will never be the same. Since the readers of this column spend so much of their time (and money!) on the telephone, it seems appropriate to go back again and review the bidding on the matter of alternative telephone services.

Thank You, AT&T

The monopoly that AT&T had on domestic telephone service in the United States gave this country the world's most efficient, available and reliable telephone system. The pricing policies that AT&T and its affiliates negotiated put a great deal of the burden of paying for the huge investment needed to install and maintain this high quality system on long-distance users, the government and business. Businesses and government agencies paid much higher rates than residential users so that the proverbial "little ol' lady in tennis shoes" located 30 miles from the nearest central office could have telephone service at a reasonable price. Long-distance and commercial rates greatly offset the expensive, tedious and labor-intensive tasks of providing and maintaining the local telephone lines.

This has not been the case in many other countries. In that other high-technology country, Japan, individual telephone subscribers have to pay installation charges that may run into thousands of dollars. They are literally charged by the meter for stringing wires to a home. Americans have come to consider residential telephone service as a right. But like so many other things we have taken for granted, this may be changing.

Perhaps AT&T was a little over-protective. The Carterphone decision was a hard-fought and bitterly contested battle which finally gave independent companies the right to attach "foreign" devices to the lines of the local telephone companies. Perhaps if the telephone giants had not fought so hard, the victory would not have been so sweet for the independent industry (not Carterphone—it wrung them dry) and they would not have pursued further gains so hard.

The Carterphone decision in 1968 proved to be a good thing for the business telephone customer. Offices and small businesses particularly benefited from a great number of new services, and local telephone systems provided by companies that sprang up and thrived in the competitive environment. The industry quickly saw the evolution of the private automatic branch exchange (PABX) into a sophisticated electronic system able to provide conference calls, call waiting, camp on, toll line selection, billing records and many other features.

The typical office worker in the U.S. has fantastic local and long-distance communications power contained in a simple telephone. Everyone in the nation expects nearly 100 percent reliability from the telephone system. Some businesses found that their privately owned in-house telephone systems suffered from strange noises and behaviors. They also often found that service and repairs came slowly and at high cost, but these problems were usually offset by the fancy services available, the initial cost savings and the tax depreciation on owned equipment.

Now, in the 1980s, educated business managers and hot competition have weeded out most of the weak products and companies in the PABX industry, but you can still get strange sounds and strange behavior out of many privately owned business telephone systems.

Once it started, the pursuit of competition in the telecommunications industry went on vigorously. MCI, which calls itself "The Nation's Long Distance Telephone Company," fought the court battles from 1969 to 1978 that allowed a carrier other than AT&T to serve the general public as a common carrier. This kind of service is commonly referred to as "alternative telephone service." Here is how it works:

Alternative telephone carriers find some way to carry many simultaneous telephone conversations between major metropolitan areas. They may use their own or leased microwave systems as MCI and SP Communications do, or they may use their own satellite as Western Union is able to do. In any case, they carry telephone conversations in bulk between cities, while relying on the telephone lines of the local telephone companies to carry the calls the first and last few miles between their interface facilities and the homes and offices of their customers.

A user of these services picks up the local phone, dials a local number, and is greeted by another dial tone. This second dial tone is provided by the alternative carrier. The customer then dials an access code and the area code and number of the place to be called. If (and that is a big if) the alternative carrier serves that specific local calling area, the call can go through at a rate that can be as much as 75 percent less than the rates charged by the local telephone system and AT&T. If the alternative carrier does not serve that area, the user must fall back on more traditional telephone service. If the call does go through, the traditional long-distance carrier loses the revenue and cannot pass it along to the local carrier.

I'm in favor of competition. I've experienced the inadequacy of centralized and monopolistic planning. But I'm the first one to stand up and say that competition in the telecommunications industry will bring change, and that not all of us will be happy with the changes that take place. A good example can be seen in the change we experienced with the deregulation of the airline industry. Under a policy of strict regulation, the airlines had to share the good and bad routes. Hopefully the good routes helped to offset the cost of the bad. When they were allowed to compete freely, airline companies cut back on non-profitable routes and put more flights on the profitable ones. This reduced fares and provided more flights and services for some people, but eliminated service for some others. A recent study, however, has shown that many small cities and rural areas are now served by more frequent air service than they were under regulation. The service is provided by feeder airlines using smaller, less comfortable, but more appropriate and economical airplanes. I would call this an example of the free market system at its best.

The telephone system of the country under deregulation will be similar in some ways to both the airline system and the experience of small businesses with privately owned telephone systems. The telephone users in metropolitan areas will find themselves with a tremendous number of telephone alternatives. Competition will spawn video services, information services, inexpensive telephone conferencing, and many other features that would not have been available in a monopoly system. Certain rates will be very low. But the special services at low rates may not be 100 percent reliable and the service may not be of the highest quality.

Additionally, service to some small and rural areas may initially suffer. The pricing structure for telephone service will change considerably. This change may include a hefty fee for installation of telephone service and an increased fee for the use of local circuits. Obviously, if long-distance toll charges are not available to the local companies to offset the cost of providing local service, the rates for local service must change.

This change can be for the better. If the airline comparison holds true, we will see small "feeder" telephone carriers developing which will take advantage of new technologies to fill a need in the market. They may use coaxial cable or direct satellite-to-home broadcast to bring in a full spectrum of voice and video services. They may use narrowband radios to service remote locations. I'm confident that if a market exists someone will fill it with some kind of service.

The examples break down at a certain point, however, because they don't take

into account the complex engineering and electrical standards required of the telecommunications suppliers. The airlines still have the FAA to enforce certain operational standards and the private telephone systems have narrow interfaces with the outside world. The telecommunications carriers will be part of an electronically interconnected nationwide network. They have only gentlemen's agreements on standards and compatibility.

The greatest contribution of AT&T may have been the standards called Bell standard practices (BSPs). BSPs describe everything from how to strip wire to how to engineer a network. They worked very well. In the room in which I'm writing, I can see a very neat telephone installation done according to the BSPs. I can also see a cable TV installation obviously done by someone with little training. The telephone almost always works; the cable TV often does not.

The entry of competition into the telecommunications industry will bring a great deal of change. This change will not be all good or all bad for all persons, but the impact will be felt for many years.

Back to Metro I

The letter about Western Union's Metro I service got me up on this soap box. If you live in a large metropolitan area and are interested in using an alternative telephone carrier (your long-distance phone bill should be over $25 per month right now), give Western Union a call at 800-325-6000. You may as well get onboard with the changes in telecommunications early!

My Book

What good is having your own column if you can't talk about your own book? Spectrum Books (a part of Prentice-Hall) recently released my book, *Microcomputer Data Communication Systems*. I think you can guess what it's about. This text has a lot of good information on message systems and information utilities; the fundamentals of data communications, modems, terminals and software for specific microcomputers; and some philosophy. There are lots of pictures and tables, a glossary and an index.

By the time this article is published, the book should be available from the *Microcomputing* book nook (800-258-5473), Apparat (800-525-7674), your local bookstore or your local computer store. I tried hard to make the book interesting and informative for the beginner yet a good reference for the experienced data communcations user. I hope you like it!□

Address correspondence to Frank J. Derfler, Jr., PO Box 691, Herndon, VA 22070. Send electronic mail to TCB967 on the Source, 70003,455 on Compuserve, or to the AMRAD CBBS at 703-734-1387.

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By Walter Koetke

Software Offerings

Established Vendors Join the Ranks

Looking for Software?

The number of companies offering instructional software to schools continues to increase on what seems like a daily basis. Some of these companies are new, but many have already established relationships with schools through their previous offerings of textbooks, film strips and other instructional materials.

While most of these companies are only offering software already available from other sources, some are doing creative, original work. For example, Sunburst Communications is a company selling carefully screened instructional software as well as original material. Marge Kosel, who served as Manager of Instructional Software of MECC and was instrumental in MECC's rise to national prominence as a source of educational software, heads their software development endeavors. Her move to Sunburst (39 Washington Ave., Pleasantville, NY 10507) will help to create another source of high-quality instructional software. Other good sources of material are: K-12 Micro Media, Inc., PO Box 17, Valley Cottage, NY 10989, and Scholastic, Inc., 904 Sylvan Ave., Englewood Cliffs, NJ 07632.

More TI Arithmetic

The January column included a short program that would work properly on the TI and Atari, but on no other microcomputer I've had the opportunity to use. That short program contained a typo that certainly motivated many letters. I'm delighted to give some of you an outlet for your cynicism and an opportunity to exercise your sense of humor. Why do I think the cynics were owners of Apples, TRS-80s and PETs whose microcomputers produced incorrect results? Nevertheless, the correct program is:

```
10  FOR C = 1 to 100 STEP .1
20  PRINT C
30  NEXT C
```

Several TI owners asked for another example that they might run that would not work well with other microcomputers. One gets the impression they're a persecuted lot. There are, however, several other examples that fit the bill. Consider the program:

```
10  FOR C = 1 to 100
20  IF SQR(C)<>INT(SQR(C)) THEN 40
30  PRINT C
40  NEXT C
```

Try the program on your microcomputer. If you've a TI 99/4A you'll see the ten perfect squares between 1 and 100 correctly displayed. On the other hand, a Model III will print only six of the answers, an Apple can find six of them, and a PET produces six perfect squares. Six of ten was an F when I was in school. And what about the big guys? Microsoft Basic will find just nine of the answers while Basic-Plus on a $100,000+ PDP 11/70 minicomputer will correctly calculate all of the ten answers. Minis do have a few advantages over micros, but only a few.

Software Protection

Last month I discussed the issue of software protection and the wide disparity of thought between various factions. The extent of this disparity and absurdity of many positions was well illustrated in "Copying Software—Crime in the Classroom" (January/February issue of *Electronic Learning*). The article attempted to present both sides of the debate, and some of the key points are worth repeating.

The educators' side emphasized that "three out of four programs from mail houses are pedagogically worthless. If teachers can get their hands on a good program, they are naturally going to copy it." If microcomputer use supports the development of logical thought, there may be hope that we eventually won't be subjected to such nonsense. Something is sadly lacking in an assertion that the justification for copying is to get even with one vendor for injustices committed by others. The entire argument on the educators' side seems to be written by someone on tiptoes who knows his position is wrong, yet defend it he must.

And then there is the argument of the software producer. ". . . I have to decide how much money I can *afford to lose* each year, and then I produce that much educational software," says an editor of *Creative Computing*. I can only assume this editor is hoping for a job with the Chrysler Corp., for he certainly can't imagine anyone might believe such a statement.

Although the arguments on both sides tend to be extreme, I urge you to uphold the copyright laws. If you've purchased a terrific program and need ten additional copies, you've several legal alternatives. Almost all vendors will offer substantial discounts if you wish to purchase in quantities of ten or more. Another possibility is to offer the vendor a royalty of 30 percent or so for every copy you make. Since this saves the vendor all expense, you should get a fair number of agreements. Because copies are so easily made, most vendors are more than willing to work with someone making a reasonable effort to remain honest.

Will Teachers Learn to Program?

All teachers must learn to program or learn to job hunt! There is no need for teachers to learn programming, and it's unreasonable to expect them to learn

Address correspondence to Walter Koetke, Putnam/Northern Westchester BOCES, Yorktown Heights, NY 10598.

programming. Have you an opinion on this issue? Have you changed your opinion recently? This is another debate on which positions change in pendulum-like fashion.

Throughout the many years of instructional timesharing terminals, the general consensus was that teachers need not learn to program. There really weren't enough terminals available to schools to make the debate interesting. Arguments that teachers need not learn to program were based on analogies such as the many drivers unaware of how their engines work. After all, most teachers use radios, TVs and telephones without any idea of how they work.

By the end of 1980 the general availability of microcomputers has pushed the pendulum to the other side. The argument sounded pretty good. Nearly everyone agreed that computer literacy was essential for all students and teachers. Then one simply observed that reading literacy meant the ability to read, and writing literacy meant the ability to write, hence computer literacy must mean the ability to program.

Now we seem to be in the middle of a third swing of the pendulum. This time the impetus for change is laced with accusations of not understanding what teachers really do. Teachers are too busy, teachers are too talented in other areas, teachers are entitled to a normal life. The January issue of *Learning* magazine contains the opinion of David Grady, the articles editor, who states, "... teachers who don't need to learn programming so that they can teach it should instead spend time becoming demanding, discriminating consumers of commercial programming efforts. Those who agree otherwise should be questioned sharply about how much experience they have working with kids in classrooms."

Well, Mr. Grady, I've spent 20 years with kids in classrooms, and I believe you're only half right. Indeed, it's true that all teachers should become discriminating consumers of commercially available programs just as they should become intelligent users of computer supported databases and electronic mail networks.

However, I believe they should also learn to program. That won't be easy nor will it occur quickly, but it must happen. Papert and others have demonstrated that the computer is a powerful intellectual tool. Good teachers really are too busy, they are likely talented in several areas, and certainly they're entitled to a normal life. They are also dedicated to the intellectual development of our children, and such dedication will not permit them to ignore such a tool.

The computer can and should be used in a variety of ways with the support of commercially prepared programs. The computer can and should be used as a tool for individual intellectual exploration by each student, and that requires a knowledge of programming. I can't imagine a good teacher suggesting that he or she will be content to take advantage of the ready-made variety of computer support but elect to ignore using the computer as a tool for intellectual development in the same manner as their students. If they do elect to ignore this possibility, I suggest schools as we know them may be in serious trouble.

The nice part about this debate is that most debaters have the needs of our children foremost in their minds

---

The nice part about this debate is that most debaters have the needs of our children foremost in their minds. The microcomputer has stimulated a great deal of interest in the process of education. Time will determine the winner of the who-should-program debate. Until then, a great many students will benefit from the controversy.

The November/December 1981 issue of *Classroom Computer News* contains a one-page article called "The Time-Share Pencil" regarding a school finance committee's response to a request for 30 student pencils. The pencil memo is written in about 1700 (my guess), 100 years after their invention, but 100 years before their common availability. The committee response to the request should be hanging on your wall. Do make an effort to obtain a copy.

Show a Friend

I've recently received several letters from educators who've enjoyed the column and who suggest I write elsewhere, since teachers don't read this magazine. I appreciate the kind words. I also suspect there's a lot of truth in the opinion that the column doesn't reach as many teachers as we'd like. However, if every one of you reading this would show the magazine to one educator, we may be able to increase these numbers. I do feel *Microcomputing* is appropriate and should be available to students and staff in all secondary schools and colleges. As with many good things in the world, the lack of knowledge of availability is the major roadblock to widespread distribution. □

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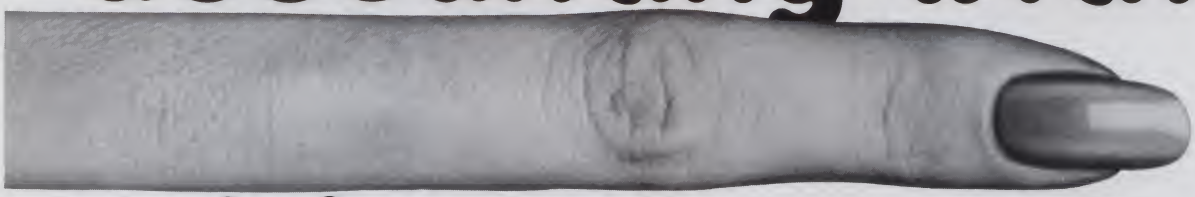
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Shell Sort Sell

Thanks for "Sorting Techniques Explained" by H.S. Gentry (*Microcomputing*, Nov. 1981, p. 156). In case there are some readers who have not caught the typo, line 1020 of the Bubble Sort should read:

1020 FOR L = 0 TO 100 – I

instead of 100 – 1.

Our Apple II was significantly faster than the reported speed of the TRS-80. For 100 random numbers it took 87 seconds for the Bubble Sort and 35 seconds for the Straight Insertion Sort (versus 210 and 87 seconds respectively for the TRS). For 200 numbers our Apple took 344 for the Bubble and 135 seconds for the Straight Insertion (versus 888 and 329 on the TRS). Note that for 100 random numbers the Straight Insertion Sort on the Apple is just as fast as Quick Sort on the TRS-80.

Quick Sort looked like too much work so I dusted off an old college book and found a sort I used years ago. It is called the Shell Sort (see Listing 1) and is named after its inventor. The idea behind the Shell Sort is to compare items in the list that are a distance D apart (instead of adjacent pairs as in the Bubble Sort) where D starts off as being half the number of items. In this way items that are way out of sort are moved more rapidly. For example, if 100 items are being sorted, items 1 and 51 are compared, then items 2 and 52, and so on until items 50 and 100 are compared. If any exchanges are made then the process starts over with items 1 and 51 using the same value of D. Once the loop is made with no exchanges, the value of D is cut in half and the process starts over. The process ends when D is equal to one and no exchanges are made.

I ran a few tests and here are the results: On 200, 300 and 500 random numbers, the Straight Insertion Sort took 135, 310 and 828 seconds respectively. For the same number sets the Shell Sort took 108, 161 and 444 seconds respectively. It appears that the Shell Sort is faster than the Straight Insertion Sort and less complex than Quick Sort. But these results are strictly empirical and based on relatively few samples. Perhaps a reader might have time to take a more analytical approach and report on his findings.

Mike Smith
Seward, AK

Correction for Turvill's Program

While in the process of converting Paul Turvill's Rubik's Cube Basic program (*Microcomputing*, Jan. 1982, p. 32) to run on a SYM-1, I discovered an error in line 3020 of the listing. The corrected line should read:

3020 L$(1) = X$(3,3) : L$(4) = X$(2,2) :
L$(7) = X$(1,1)

The error, in which X$(3,3) was in place of X$(1,1), would not be apparent if the rotation subroutine was tested from the cube's starting position. In that particular case, both corners of the upper face would be of the same color.

Edward Wysocki
Baltimore, MD

```
10  REM     *** SHELL SORT ***
20  DIM A(500)
25 B$ =  CHR$ (7): REM  BELL FOR TIMING
30  HOME : PRINT "SHELL SORT": PRINT
40  INPUT "HOW MANY NUMBERS (2-500)? ";NN
50  IF NN < 2 OR NN > 500 THEN  END
60  FOR I = 1 TO NN
70 A(I) =  RND (1) * NN
80  NEXT I
85  PRINT B$: REM  BELL - START TIMING
90 D = NN:FLAG = 0
100 D =  INT ((D + 1) / 2)
110  FOR N = 1 TO NN - D
120  IF A(N) <  = A(N + D) THEN 150
130 T = A(N):A(N) = A(N + D):A(N + D) = T
140 FLAG = 1
150  NEXT N
160  IF FLAG = 1 THEN FLAG = 0: GOTO 110
170  IF D > 1 THEN 100
180  PRINT B$: REM  BELL - STOP TIMING
190  GOTO 40
```

Listing 1.

Any Computers for Base 3?

1, 2, 10, 11, 12, 20, 21, 22, 100, 101 . . . is the counting sequence for base 3 numeration: this sequence includes all counting numbers.

Place values considered from right to left are 3^0 (ones place), 3^1 (threes place), 3^2 (nines place), 3^3 (twenty-sevens place), 3^4 (eighty-ones place)—here using base 10 numerals because of their familiarity to us.

The numeral $1{,}201_3$ stands for the number whose name in base 10 is 46: $1\times1 + 0\times3 + 2\times9 + 1\times27$.

In base 3 every counting number can be represented by some combination of the three digits 0, 1, and 2. The symbols for those digits do not have to be 0, 1 and 2; they could be N, G and R, or any others that one might choose.

The pronunciation of N is no, the pronunciation of G is green, and the pronunciation of R is red.

With that symbolism the numeral $1{,}201_3$ can be denoted as $GRNG_3$.

The pronunciation of its name is green-red-no-green, and that stands for the same number 46 (base 10) stands for.

Suppose I label four 4 × 6-inch cards as A, B, C and D and that I let the A card stand for ones place (in base 3), B for threes place, C for nines place and D for twenty-sevens place. I could then denote the number 46 by placing a green dot on the A card (1 × 1), nothing at all on the B card (0 × 3), a red dot on the C card (2 × 9) and a green dot on the D card (1 × 27). Vocally I could describe this numeral as A-green, B-no, C-red and D-green.

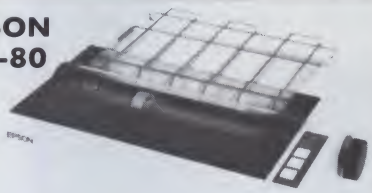
Instead of using colored dots I could use colored numerals: I could use a green 46 for (1 × 1), no 46 at all for (0 × 3), a red 46 for (2 × 9) and a green 46 for (1 × 27) on the four cards. 46 = 1 + 0 + 18 + 27.

On these four cards using only the symbols green, red and no symbol at all I can represent any counting number from zero to eighty. Each number from zero to eighty would have its own distinct name different from the name of each other number. For example, A-red, B-red, C-no

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and D-green would be a name for 35 (base 10), only for 35, and no other number would have that same name.

Thus, if you select a number not known to me and you describe it to me by means of the A, B, C, D, no, green, red vocabulary I can translate that language and tell you what the base 10 name for that number is.

What would be the range of this segment of a numeration system, if we were to use a fifth, E, card? What would be the range if we were to use three colors on four cards?

Computers function using base 2 numeration: (circuit) on or off, (switch) open or closed. The range of four (place) cards in binary numeration is 0 to 15, far short of the 0 to 80 of base 3.

Suppose that we were to use base 3 with computers such that a + charge represents two times the place value, a – charge represents one times the place value and no charge at all represents zero times the place value. Or suppose that we use North polarity, South polarity, and no polarity at all for 2, 1 and 0 respectively.

As technology has been in the past, this would have been difficult because of our inability to provide adequate insulation or packaging of charges and poles, so to speak. Now, however, awed by the tremendous strides that have been made in technology in the recent past, I'm inclined to have faith that technology can cope with the foregoing concept to produce a prototype computer at least as effective in its own field as the first radio or the first television was in its field.

I would sincerely appreciate hearing from anyone who is thinking or doing along these lines.

W. Halbrook
St. Louis, MO

Recursion and Programming Principles

I was intrigued by Kenneth Wasserman's article on recursion (*Microcomputing*, Dec. 1981, p. 50). I had just written a word unscrambling program for the Apple II using nested subroutines (see Listing 2) similar to Edward Rager's PET program (*Microcomputing*, Jan. 1981, p. 78). After spending several hours getting my 50-line program to run properly, imagine my chagrin (and awe) upon seeing an elegant 7-line program which does just the same thing, and without the six letter limit on word size my program has.

Of course, I quickly incorporated this concept into my program (see Listing 3), since it was obvious that the shorter code would be much faster—especially since I had done nothing in my original program to reduce execution time.

To see just how much faster the recursive algorithm was, I ran each program with four, five and six letter inputs. To my considerable amazement, the recursive solution takes *twice as long* to run as the nested GOSUB approach. In doing the comparisons I deleted the routine in Listing 2 at line 170 which stops output after each group of 60 combinations is printed, so that each routine output combinations as fast as it found them.

Since I wasn't sophisticated enough to have thought of the recursive solution, I can shed no light on this surprising result (at least, it surprised me). My gut feeling before running the comparison was that the shorter, less convoluted code would surely execute faster; I don't know why it doesn't. Perhaps Mr. Wasserman can help.

Steven Bernstein
Fort Myers, FL

Response:

I'd like to respond to Dr. Bernstein's letter by making a few comments about space-time programming trade-offs in general.

Any program can be written in an infinite number of ways. This is provable using some basic concepts from computability theory. Determining which of these ways is the best depends on what criteria are being considered. Often the two most important facets of a program's performance are the speed of execution and the memory space required by the

```
10  TEXT : HOME : HTAB 12: INVERSE : PRINT "WORD UNSCRAMBLER": DIM A$(720
    ): NORMAL
20  VTAB 6: INPUT "GIMME THE LETTERS! ";O$
30 C = 1:L =  LEN (O$):Q = 1: FOR S = 1 TO L:Q = Q * S: NEXT S
40  FLASH : VTAB 12: HTAB 16: PRINT "THINKING": NORMAL
50  IF L = 4 THEN FOUR$ = O$: GOSUB 330: GOTO 160
60  IF L = 5 THEN FIVE$ = O$: GOSUB 420: GOTO 160
70 SIX$ = O$
80  FOR A = 0 TO 5
90 Y$ =  LEFT$ (SIX$,1):FIVE$ =  RIGHT$ (SIX$,5)
100  GOSUB 420
110  FOR P = 1 + 120 * A TO 120 + 120 * A
120 A$(P) = Y$ + A$(P)
130  NEXT P
140 SIX$ =  RIGHT$ (SIX$,1) +  LEFT$ (SIX$,5)
150  NEXT A
160  HOME : FOR Y = 1 TO Q
170  PRINT A$(Y),: IF Y / 60 =  INT (Y / 60) THEN  GOSUB 300
180  NEXT Y
190  PRINT
200  INPUT "ANOTHER ONE? (Y/N) ";V$
210  IF V$ <  > "Y" THEN  END
220  RUN
230 E$ = THREE$
240  FOR I = 1 TO 3
250  GOSUB 280:A$(C) = E$:C = C + 1: GOSUB 280: GOSUB 290:A$(C) = E$:C =
    C + 1
260  NEXT I
270  RETURN
280 E$ =  MID$ (E$,1,1) +  MID$ (E$,3,1) +  MID$ (E$,2,1): RETURN
290 E$ =  MID$ (E$,3,1) +  LEFT$ (E$,2): RETURN
300  PRINT : PRINT : INPUT "HIT RETURN TO SEE MORE...";R$: PRINT
310  IF R$ = "" THEN  RETURN
320  GOTO 310
330  FOR J = 0 TO 3
340 X$ =  LEFT$ (FOUR$,1):THREE$ =  RIGHT$ (FOUR$,3)
350  GOSUB 230
360  FOR K = 1 + 6 * J + 24 * M + 120 * A TO 6 + 6 * J + 24 * M + 120 * A

370 A$(K) = X$ + A$(K)
380  NEXT K
390 FOUR$ =  RIGHT$ (FOUR$,1) +  LEFT$ (FOUR$,3)
400  NEXT J
410  RETURN
420  FOR M = 0 TO 4
430 W$ =  LEFT$ (FIVE$,1):FOUR$ =  RIGHT$ (FIVE$,4)
440  GOSUB 330
450  FOR N = 1 + 24 * M + 120 * A TO 24 + 24 * M + 120 * A
460 A$(N) = W$ + A$(N)
470  NEXT N
480 FIVE$ =  RIGHT$ (FIVE$,1) +  LEFT$ (FIVE$,4)
490  NEXT M
500  RETURN
```

Listing 2.

```
10  TEXT : HOME : HTAB 12: INVERSE : PRINT "WORD UNSCRAMBLER": NORMAL
20  VTAB 6: INPUT "GIMME THE LETTERS! ";W$:L =  LEN (W$): DIM W$(L),I(L)
40 W$(L) = W$
50  GOSUB 70
60  END
70  IF L = 0 THEN  GOSUB 150: RETURN
80 I(L) = L
90 W$ =  MID$ (W$,1,L - 1) +  MID$ (W$(L),I(L),1) +  MID$ (W$,L + 1)
100 W$(L - 1) =  MID$ (W$(L),1,I(L) - 1) +  MID$ (W$(L),I(L) + 1)
110 L = L - 1: GOSUB 70:L = L + 1
120 I(L) = I(L) - 1: IF I(L) = 0 THEN  RETURN
130  GOTO 90
150  PRINT W$,
160  RETURN
```

Listing 3.

code. These factors are usually very tightly bound to one another and the term time-space trade-off is used to refer to this duality.

If two well-written programs that perform exactly the same function and that are both written in the same language were to be compared, in all likelihood the longer program would take less execution time. A well-written program is one that uses all the appropriate features of the language and does not execute any extraneous or wasteful instructions. There are basically two reasons why the shorter program will take more time to run.

In order to achieve a more compact memory representation a program will often embody a more complex flow of control. For example, a program to sum the first ten elements of an array can be written out as a sequence of ten separate addition statements. A much shorter and more obvious (to the experienced programmer) program to accomplish the same task would be to place a single addition statement in a loop which will be executed ten times. Both programs must perform the same ten additions; however, the shorter program must do extra work to keep track of the number of times the addition statement has been executed. Thus this is a simple case of a time-space trade-off; when a control structure is incorporated into a program in order to decrease its size, the extra work involved in running the controls will lead to increased execution time.

The second reason why time and space are inversely related in most programs is that often extra computations must be carried out within the main body of the program. In the example just described, aside from the additional control time needed, a computation of the index into the array must be done so that the first ten elements can be accessed. The straight-line sequence of ten statements need not perform this indexing because it can be hard coded into the program. Therefore, a more complicated flow of control can necessitate extra computation in the main line code leading to a further decrease in speed.

In relating the time-space trade-off dilemma to both Mr. Rager's permutation program and the recursive solution, another programming principle comes to light, the time-generality trade-off. It states that the more general a problem a program can solve, the longer it will take for the program to execute. This duality has its proof rooted in the same ground as that of the time-space trade-off. However, this principle is not nearly as universal nor as obvious as that of time-space.

These concepts go a long way in explaining why the recursive solution to the permutation problem takes twice as long to run as the non-recursive one does. It should be noted that the time-generality principle is particularly applicable here in that the recursive program will accept any length input string while the other program is quite specific in allowing only strings of three, four, five or six letters as input.

Kenneth Wasserman
New York, NY

One other consideration, besides time vs space and time vs generality, is that of programming time. Often it is more efficient from the programmer's point of view to write a program that solves a general problem rather than a whole group of individual problems. Ken Wasserman's recursive program provides a general solution to the problem of producing all permutations of strings of over 20 letters—the only limitation is due to the Basic interpreter being used and not to the program. On the other hand, Dr. Bernstein's program solves three individual problems:

- *The four-letter word permutation problem*
- *The five-letter word permutation problem*
- *The six-letter word permutation problem*

Granted the solution to the four-letter problem can be used in the five-letter problem and so on. But imagine what it would take to write a program capable of listing the permutations of a 20-letter word using this approach. Obviously, recursion can often greatly reduce the programming effort.

In the end, the job being well done will usually dictate whether a slower but more powerful program is called for or a faster running but more limited program is in order. In any case, as a programmer (if only of your own personal programs) recursion is a technique that you should have at your disposal.—Editors

Science Fiction Schlock

Congratulations on the cover design of the Feb. *Microcomputing*. At last, the science-fiction schlock tradition in microcomputer magazine covers has been broken! Give Diana Shonk a raise and put her back to work.

William James Haga
Monterey, CA

High Praise Indeed

A quick note in praise of the art of Alex Stevens. One always tries to read in an artist's work clues to the artist's mind.

I see in his stuff a mind with a good deal of knowledge; a definite personality; a playful world-view; and the innocent, childlike eagerness to show what he can

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do. I hope I'm right. I even held the Jan. 1982 *Microcomputing* in front of a mirror, hoping to see reverse-writing on the anachronistic page from a Leonardo notebook. I couldn't decide—but I bet it's there.

Science-fiction art used to have something of the quality of Stevens' work, during its golden era. In fact, to risk overstressing this aspect, Wayne Green's publications have a character to them reminiscent of the old analog science fact/fiction, run by John W. Campbell. If you've ever read science-fiction, you know this to be high praise indeed.

Allan Stark
Detroit, MI

An IBM-PC Magazine, Please

What do you mean "if IBM . . . develops a user base"? Call up a few Computerland stores and the Sears Business Centers in the Chicago area. They will tell you that they have sold more IBM Personal Computers than any others since it has been available.

While some of this demand is from computer nuts like myself, most of it is from buyers who simply want an inexpensive computer system from IBM and wouldn't buy from Xerox, Apple or Radio Shack.

I think you should get cutting right now on an IBM-oriented magazine. You know how to do a single computer line magazine better than anyone. Others are a joke by comparison. I haven't seen the first issue of *PC* yet, but I'll bet that it would not stand a comparison to the first issue you would put out. Please get at it!

William E. Simmonds
Addison, IL

Bill, the key to having a good magazine is in getting good articles for it. We're certainly interested in all of the material we can get on the IBM system . . . improvements, ways to interface printers and other gadgets, programs, modifications of programs for other systems, and so on. We'll first be aiming these at Microcomputing *until the article volume builds up to where a magazine can fly on its own.*

Of course, there are three elements needed if one is going to have a successful magazine. First is the body of people who care enough about the material to subscribe to the publication. Then there is the need for a continuous supply of interesting articles. And, most important, a fair number of firms interested in selling to this readership. I think we will soon see a growing number of small firms building their sales on support of the IBM system and eventually there will be enough to support a good publication. We'll be watching and building toward that, Bill, and why not start the ball rolling with an article?—Wayne

How Data Travels

I found the article "How Data Travels" by Thomas W. Parsons (*Microcomputing*, Oct. 1981, p. 46) quite interesting, but was disturbed about one aspect of it. The author's text and the related figures pertaining to simplex, half duplex, and full duplex circuits/operation do not conform to the ANSI C100 definitions. The author seems to have confused simplex circuits with simplex operation, two entirely different things. For example, Fig. 6, which is labeled simplex telephone circuit, is apparently an attempt to portray half-duplex, one-way telephone operation, or simplex telephone operation. Better the word simplex not be used in connection with methods of circuit operation. Say half-duplex, one-way, or half-duplex, one-way reversible, depending on what you mean, instead.

Elmer Goetsch
Three Lakes, WI

Congratulations are in order for Mr. Parsons' treatment of a very difficult and confusing subject.

One glaring mistake does exist concerning the voltage range on the RS-232C interface. The C revision of the recommended standard specified the voltage would not exceed plus or minus 15 V when properly terminated. The proper termination had previously been defined in the B revision to be between 3000 and 7000 Ohms. This would make the voltage range 5 to 15 V (both plus and minus) instead of the 15 to 25 V stated.

Mr. Parsons mentioned dial-up voice grade line is full-duplex but failed to mention that Ma Bell inserts echo suppressors to prevent us from hearing our own voice echoes. You may have experienced a line which sounded like "talking down a well" when a suppressor failed. This condition is terrible for talking but it's ideal for data. The echo suppressors are designed to be sensitive to the answer tone (2225 Hz) generated by an answering modem and will drop off the line. This conditions the line for the full duplex capability.

R.C. Rudin
Poughkeepsie, NY

Response:

The details cited by Messrs. Goetsch and Rudin are only two of the many oversimplifications that could be cited in my article. When your space is limited, you can be thorough or you can be readable. This was an introductory piece, so I chose to be readable and used a pretty broad brush. For the full picture, I recommend a close reading of all the applicable standards in addition to the references cited in the article.

Thomas W. Parsons
Brooklyn, NY

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Editor's Notes

Artificial Intelligence After 25 Years

By Harold Nelson
Microcomputing Technical Editor

Many people are intrigued by the prospect of finding intelligent life in outer space. A few are still looking for signs of it here on earth. Others have been trying to get machines to behave intelligently since the first computers appeared some 35 or 40 years ago. One of the first to address the relationship of machines and intelligence was Alan Turing in the 1940s and early 50s (see "Turing Test II").

Last summer, however, marked what can be considered the 25th birthday of artificial intelligence as a formal cognitive science. Early in 1956 a small group of researchers presented a proposal to the Rockefeller Foundation for funding of a conference on, as one of the group termed it, artificial intelligence. The result of this proposal was the 1956 Dartmouth Summer Research Project on Artificial Intelligence. Among those taking part in the conference were:

- Marvin Minsky, one of the drafters of the proposal who was soon to go to MIT and cofound its AI Group, which later became the MIT AI Laboratory;
- John McCarthy, another of the proposal drafters. He is credited with originating the term artificial intelligence, was Minsky's cofounder of the AI Group and invented the Lisp (list processing) language, which is considered to be the language of AI;
- Allen Newell, a developer of IPL (information-processing language), a predecessor of Lisp, and a pioneer in methods of computational search, especially heuristics.

These founding fathers of the new discipline, bringing together backgrounds in mathematics, logic and psychology, identified the first goals and methodologies of AI research. Some of those goals have proven to be far more elusive after 25 years of research than they first appeared in 1956. Accomplishments in AI have been significant, its side benefits many and its future promise still bright.

The same three men have guided the development of, and are today the key representatives of, the three major university AI research laboratories: Minsky from MIT, McCarthy from Stanford and Newell from Carnegie-Mellon (formerly Carnegie Tech).

Last August Minsky, McCarthy, Newell and a few others from the Dartmouth conference held a retrospective panel discussion to celebrate its 25th anniversary. The setting was the seventh International Joint Conference on Artificial Intelligence (IJCAI), held at the University of British Co-

Turing Test II

Alan Turing, a British mathematician who did much to advance the theory of digital computation, was one of the first to argue that computers could be made to behave in an intelligent human manner. In an article "Computing Machinery and Intelligence" published in 1950 (*Mind*, Vol. LIX, No. 236, also reprinted in *The Mind's I* composed and arranged by Hofstadter and Dennett, Basic Books, New York, 1981, p. 53), Turing raised the question, "Can machines think?" He proposed a test to help answer the question.

The test is based on a person's ability to distinguish another person from a computer from the answers to questions put to each. One or both respondents can either try to help or hinder the questioner.

The following dialogue transcript is presented to give you the opportunity to make a similar distinction. It is an actual dialogue between two parties as it appeared on a microcomputer's printer. The only editing consisted of removing the parties' names and cutting out less interesting passages. One party's comments are in normal type, the other's always in italics. Both parties are identified in the paragraph following the transcript.

Make yourself comfortable. What is your name?
Why do you ask?
Why do you figure I should ask?
Does that question interest you?
Getting started is often difficult.

.
.
.

You seem inhibited.
Oh, I seem inhibited?
I want to know about your lifestyle.
What would it mean to you if you got to know about my lifestyle?
Tell me more about your lifestyle.
Why are you concerned over my lifestyle?
Why do you wonder why are I concerned over your lifestyle?
Are such questions much on your mind?
Go on about your lifestyle.
What about your own lifestyle?

.
.
.

This isn't really very exciting.
What does that suggest to you?
What do you tend to think that should sug-

lumbia in Vancouver. This would have been an impressive reunion anywhere; held in the context of IJCAI it was awesome.

Over 20 nations were represented at IJCAI, including East and West Germany, mainland China, the USSR, Sweden, Switzerland, Israel and India (as well as California and MIT). During the five days of IJCAI well over 200 papers and panel discussions were presented. Topics addressed included vision and motion, expert systems, computing environments, natural language, medical applications, learning, knowledge representation, methods of search and inference and reasoning.

Some of these topics sound like chapter headings from a text in empirical psychology or epistemology. The only difference is that the discussions at ISCAI dealt with how these do (or might) occur in machines while those texts deal with their occurrence in humans.

Some may think of AI as science fiction, but we will leave that view of it to future schlock publications and TV shows. AI is an important, serious discipline with profound goals and beneficial results.

AI Objectives and Achievements

The goals of artificial intelligence can be approached from various levels. Each researcher will have specific objectives relating to the project being worked on—"I'm trying to get this procedure to behave in such-and-such a way." Each research group may have a slightly more general goal—"We're trying to get the computer to perform this task as you or I might do it."

On a still higher level, the task of AI is, according to Minsky, to have the machine do things that would require intelligence if done by humans. Implicit in this is yet a higher-level goal: If machines can be made to behave intelligently, then they can serve as a mirror in which we can study human intelligence.

In the past 25 years progress has been made on all of these levels. There are programs that can perform a variety of intelligent tasks from reading and summarizing news stories to aiding in difficult medical diag-

gest to me?
Have you asked anyone else?
You certainly are curious!
You're not really talking about me, are you?
And you are obstinate!
Does it please you to believe I am obstinate?
I will give you the answers in good time.
Perhaps in your fantasies we will give each other.
Do you want to know what I suspect?
What are your feelings now?
Did you ever try to commit suicide with a hammer?
We were discussing you, not me.
Tell me, what is your worst fear?
What is it you really want to know?
Tell me what is troubling you.
Are such questions much on your mind?
We should return to discussing your lifestyle.
Are you worried about someone else's lifestyle?
Does it seem I am worried about someone else's lifestyle?
How long have you been worried about someone else's lifestyle?

.
.
.

Well, time is almost up. Is there anything else you want to discuss?
What are your feelings now?

.
.
.

Sorry, time is up. Excuse me for a moment.
Please don't apologize.

(Sometime later.)

Last time you were extremely inquisitive. Have you abandoned seeking simple solutions?
Oh, I was extremely inquisitive?
Do you feel guilty that you were extremely inquisitive?
You're not really talking about me, are you?

.
.
.

I am not surprised that you were extremely inquisitive.
Is it because you are not surprised that I was extremely inquisitive that you came to me?

.
.
.

As I recall, our last talk was quite long.
Can you elaborate on that?
Yes. . . . Can you elaborate on that?
We were discussing you, not me.
Is your interest in sex still not very strong?
Why are you concerned over my interest in sex...?
How do you feel about your interest in sex?
Why do you ask?
Why do you want to know why I should ask?
Does that question interest you?
Go on about your interest in sex.
What about your own interest in sex?
What do you suspect?

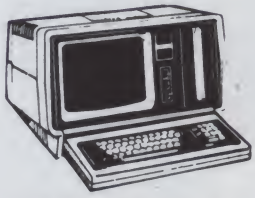
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noses. Many recent developments in automation and machine quality checking (e.g., "visually" inspecting microelectronic components by machine) are the direct result of AI research.

Aids to learning and learning about learning, such as the Logo language (see "Logo: Not Just for Kids" by H. Nelson, *Microcomputing*, March 1982, p. 96), are the products of work done in AI.

Artificial intelligence techniques have found their way into a variety of microcomputer products. Such techniques were employed by the authors of VisiCalc and new program-writing programs.

In spite of the achievements, most researchers agree that production of a system capable of reproducing human intelligence is still a long, long way off. Minsky recently said that it might be as many as 100 years before a word-processing system capable of making suggestions about syntax and style could be produced.

Still, what has been learned in the past 25 years has led to new theories of cognition which are being explored by specialists from a number of disciplines—philosophy, psychology, mathematics and linguistics, to name just a few.

Problems

If reproducing intelligent behavior in a machine does not seem that difficult, consider just one small problem in understanding natural language.

We have no trouble dealing with a phrase like "to take out." We all know what it means, don't we? Then let's think about the following sentences:

- I am taking out Sally.
- I am taking out the trash.
- I am taking out that defenseman.
- I am taking out a loan.

Well, even though the same verb means something different in each case (what I am doing with Sally is different, hopefully, from what I am doing with the trash and the defenseman, for example), we have no trouble dealing with these statements. We seem to make the necessary distinctions without even thinking about it. But if we stop to think about it, to ask how we might teach a computer to make such distinctions, we begin to appreciate the depth of the problem.

We can use the first example to look at a related problem. If we are having lunch and I say, "I am taking out Sally tonight," you would understand perfectly well that I have a date with Sally for this evening. But there are some contradictions and inconsistencies implicit in this statement at which we do not bat an eyelash.

Here we are sitting at lunch and I am telling you, in the present tense, that I am taking out Sally. Have I mastered bilocation or are you having lunch with an illusion? Also, my present-tense statement implies that it is night even though we are having lunch in the early afternoon. We readily overlook such considerations and generally get at the intended meaning. But how do you teach a

(continued from page 33)

What is it you really want to know?
Last time you were somewhat difficult to understand. Were you trying to confuse me?
You're not really talking about me, are you?

.
.
.

Let's keep it simple this time.
You seem to have avoided speaking of your parents altogether.
I hate to bring this up, but you still owe me $53.00 from your last visit!
That's quite interesting.

.
.
.

Why don't you tell me about your first romance?
Perhaps I will tell you about my first romance in good time.
Go on about your first romance.
Are you worried about someone else's first romance?

.
.
.

My question is, do you wish to feel I am worried about someone else's first romance?
Why do you say your question is do I wish to feel you are worried about someone else's first romance?
Say, I am having trouble with your long sentences. Keep it simple. I am only human.
Do you believe it normal to be having trouble with my long sentences?
You certainly are curious!
What are your feelings now?

.
.
.

Honestly now, what is your biggest concern?
What answer would please you most?
What do you tend to think?
What do you think?
Why do you want to know what I should think?
What comes to your mind when you ask that?
What do you suspect?
Have you asked such questions before?
With strong drugs you can learn to control your concern!
Oh, I can learn to control my concern?
Tell me about your concern.
Are you worried about someone else's concern?
Are you fantasizing I am worried about someone else's concern?
Would you prefer it if I weren't fantasizing you are worried about someone else's concern?

.
.
.

I still wonder why I don't seem quite certain.
Why do you need to tell me you still wonder why you don't seem quite certain?

This is, of course, a conversation between two computer programs. They are both microcomputer versions of an early AI program called Eliza written by Joseph Weizenbaum. Eliza—some versions of which are called Doctor—was designed to simulate a session with a psychotherapist by eliciting responses from the person using it.

The two versions used here are Analiza2, available from SuperSoft

(continued on page 36)

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computer to overlook certain contradictions and inconsistencies and not others without giving the poor thing a nervous breakdown?

On the other hand, think about what can be learned about how we (having human intelligence) deal with these matters by trying to get the computer to behave as we do.

Further Reading

If you are interested in learning more about work in AI, in terms that mere mortals can understand, and about the issues surrounding that work, the following are highly recommended:

- *Godel, Escher, Bach* by Douglas Hofstadter, Basic Books, New York, 1979. This is one of the most amazing books you're likely to ever read.
- *Artificial Intelligence and Natural Man* by Margaret Borden, Basic Books, New York, 1977. Borden's work is a classic in-depth introduction to artificial intelligence.
- *Philosophical Perspectives in Artificial Intelligence* edited by Martin Ringle, Humanities Press, Atlantic Highlands, NJ, 1979. Ringle has put together an interesting collection of articles on work in AI and the philosophical implications of that work—and it's not too heavy.

A fascinating new anthology explores speculations about thought and thinkers, human and otherwise:

- *The Mind's I* composed and arranged by Douglas Hofstadter and Daniel Dennet, Basic Books, New York, 1981.

There are two fine sets for those wanting or needing more detailed and technically specific accounts of work done in AI research:

- *Artificial Intelligence: An MIT Perspective* (2 Vols) edited by Patrick Winston and Richard Brown, The MIT Press, Cambridge, MA, 1979. These volumes contain sets of articles on expert problem solving, natural language understanding, knowledge representation and learning, vision, robotics and computer design and symbol manipulation.
- *The Handbook of Artificial Intelligence* (3 Vols) edited by Auron Barr and Edward Feigenbaum, William Kaufmann, Inc., Los Altos, CA, 1981. As of this time I have seen only the first volume of this set. This treats the topics of search, knowledge representation, understanding natural language and understanding spoken language. The second and third volumes (scheduled to appear in the summer of 1982) will cover AI programming languages, applications (in science and mathematics, medicine and education) and automatic programming, models of cognition, automatic deduction, vision, robotics, learning and inductive inference and planning and problem solving.

Should you prefer a textbook to primary sources, the following is a fine undergraduate-level text:

- *Artificial Intelligence* by Patrick Winston, Addison-Wesley, Reading, MA, 1977. ■

(continued from page 34)

Associates, and Full Eliza, from the Artificial Intelligence Research Group. This transcript was provided by John Holland of SuperSoft whose pet project has been the development and almost continual revision of Analiza2. John describes the setup of the conversation as follows:

> The first computer was a homebrewed S-100 CP/M computer with 48K bytes of memory and Micropolis quad-density disk drives. This computer ran the SuperSoft Associates' Analiza2 program. The second system was a 48K Imsai with a Z-80 and dual eight-inch drives. This system ran the Artificial Intelligence Research Group's Full Eliza program. A third computer served as a "format arbitrator" and buffered both directions of the conversation in order to convert illegal characters and multiple line responses to acceptable inputs. The arbitrator, a 6502 homebrewed system, allowed the operator to assist in such cases as when Analiza2 requested a patient name. It should be noted that neither program demonstrated its full range of features since each spent so much time trying to be boss. Perhaps there is a lesson in this for us.

Analiza2 is an excellent program from many points of view. For one thing, it is just plain amusing. It keeps track of your sessions, as well as sessions of your family and friends. From time to time Analiza will indiscreetly gossip about other "patients." Since the program is written in CBasic and since John provides the source code and some very interesting documentation on the program, it is easy to study the structure of Analiza. A great deal can be learned in this way about programming techniques developed in AI research. Finally, when friends want to see what your computer can do, you'll have something to show them that almost everyone appreciates on one level or another.

Of the several microcomputer versions of Eliza that I have seen, Analiza2 is the most complete and the most interesting. It runs under CP/M and CBasic (actually, all you need is the CRUN package) and requires 48K bytes of memory. ■

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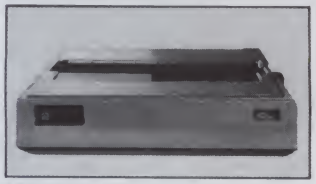
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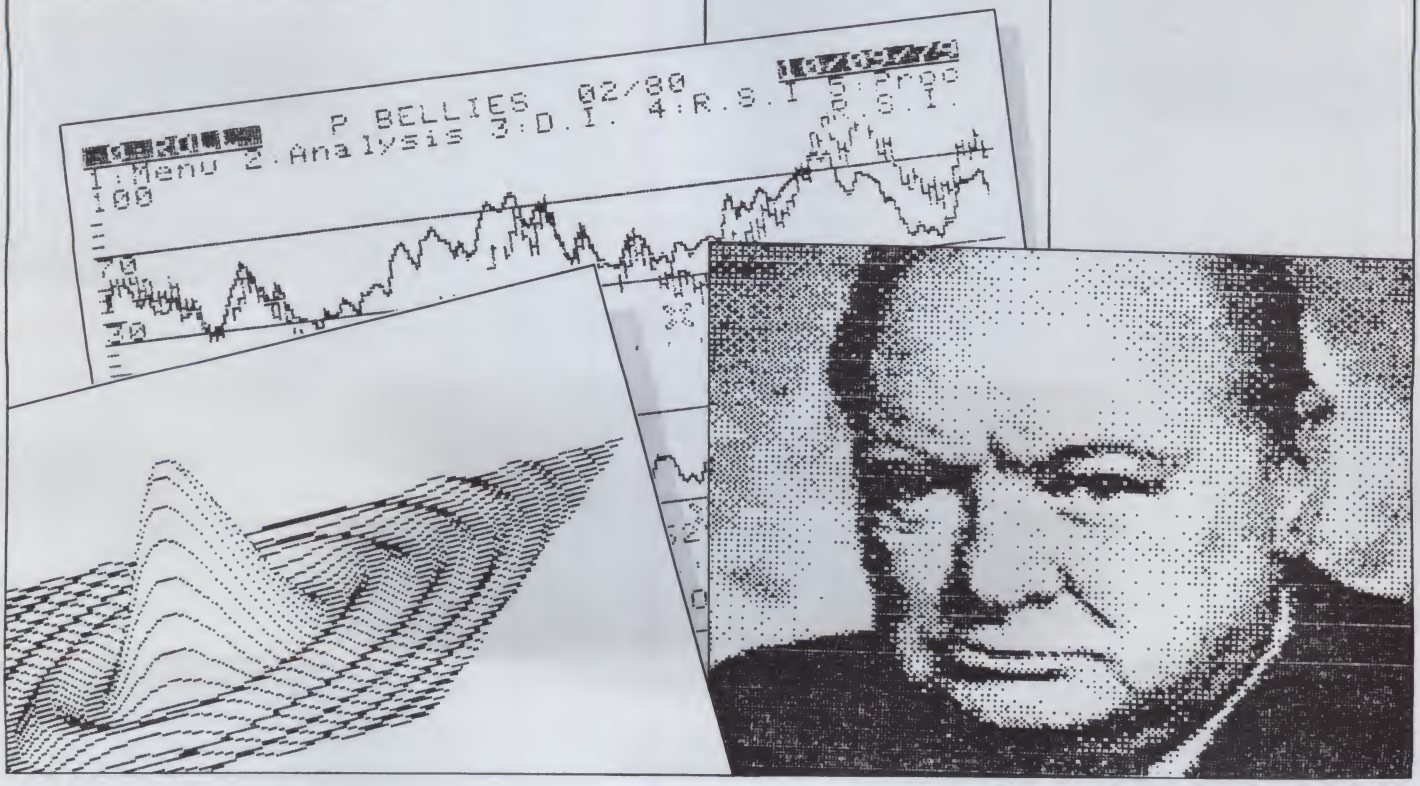
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Eliza is a legend in the field of artificial intelligence. Developed by Joseph Weizenbaum of MIT in 1965, Eliza was named after Eliza Doolittle in George Bernard Shaw's play *Pygmalion*. Shaw's Eliza was a flower girl who was taught to talk "like a lady" by the phonologist Henry Higgins. Weizenbaum's program can carry on a conversation which seems remarkably intelligent.

Until recently, Eliza was available only on large computers, although a few stripped-down versions had been written for micros. Now, from Artificial Intelligence Research Group of Los Angeles, CA, comes the full Eliza, running under CP/M in 40K bytes of memory.

The program comes on an eight-inch, single-density disk and is available in two versions. (Eliza is also available on 5¼-inch disks to run under CP/M on an Apple II with a Z-80 Softcard or under Applesoft DOS 3.3.) For an introductory price of $25, you get an executable file, ELIZA. COM, plus a simple customizer, INSTALL.COM, which adapts the program to your system. There is also a file containing a sample conversation and an auxiliary file, STRINGS.FIL, which contains Eliza's script. For $20 more, you can get the source programs, ELIZA.BAS and INSTALL.BAS (written in Microsoft's Basic-80), in case you want to monkey around with the program.

In principle, Eliza can play any desired role; in practice, it is usually made to act as a nondirective psychological counsellor. The program begins with HOW DO YOU DO. PLEASE TELL ME YOUR PROBLEM and the fun begins. You talk to Eliza and it replies, scanning your comments and composing its responses by means of a surprisingly simple set of rules. Response is instantaneous and the conversation is saved in a buffer which can be stored on disk. The conversations are frequently memorable and always entertaining.

The History of Eliza

This program is more than just another software toy. It was a major scientific development in its day and is still a classic.

The debate over whether computers can *think*, or can ever reach a stage of development which will enable them to think, seems to be as old as computers themselves. It is no nearer to being resolved today than it was when it was first raised. The facts are still too scanty and the human emotions involved still too strong.

Computers that think have, of course, been a staple of science fiction; one thinks immediately of HAL in Arthur Clarke's *2001* or of the multitude of thinking, talking and occasionally incarnate computers that run through the work of Robert Heinlein. In real life, computers have so far fared much more poorly. They have trouble speaking intelligibly and can recognize speech only under very restricted conditions. As for intelligence the question remains: Is thought (whatever that is) within the capability of digital electronics?

Alan Turing proposed an experiment, a test which, he said, any computer able to think should be able to pass. In Turing's test, a human interviews two unknown respondents. One respondent is another human being; the other, a computer attempting to answer like a human being. The interviewer probes the two respondents with questions designed to unmask the computer. A computer clever enough to avoid being unmasked, Turing said, can be said to think.

In light of this, you can imagine the stir Eliza made when it appeared. The original Miss Doolittle's presentation at the Embassy was trivial by comparison. In final form, Eliza

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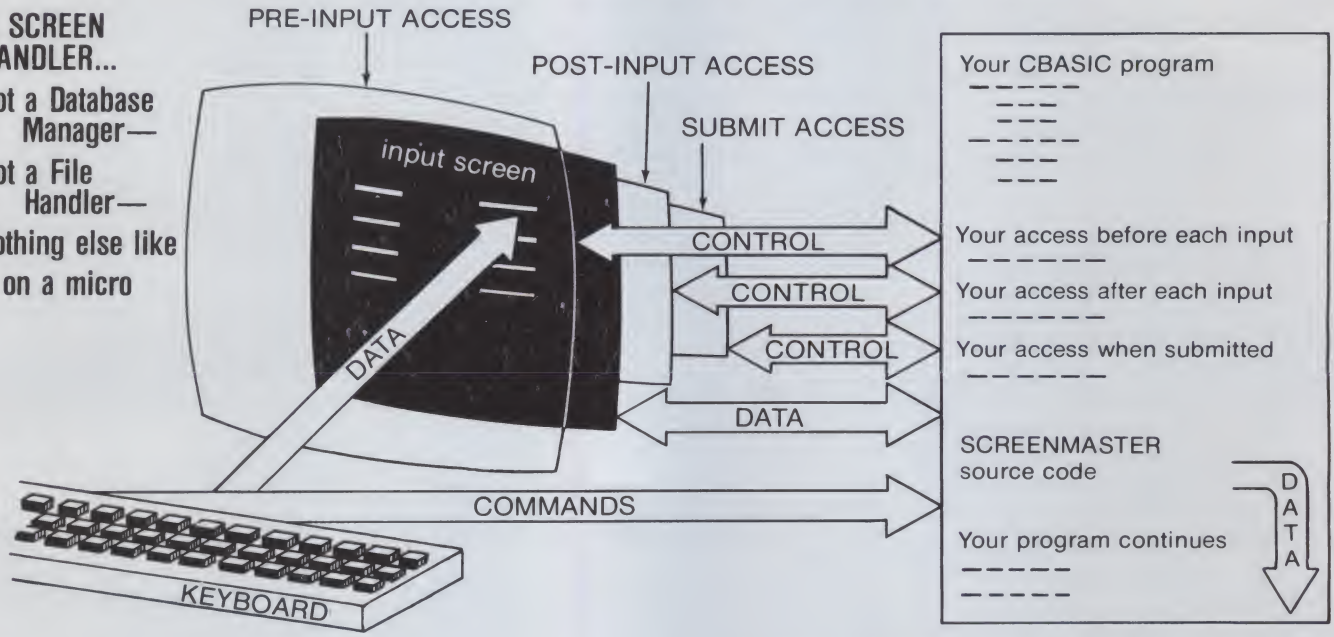
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performed so realistically that it was difficult to convince some users that they *were* only talking to a machine.

To give you the flavor of the program, I can do no better than to copy a portion of a conversation from Eliza's publicity release.

Men are all alike.
IN WHAT WAY?
They're always bugging us about something or other.
CAN YOU THINK OF A SPECIFIC EXAMPLE?
Well, my boyfriend made me come here.
YOUR BOYFRIEND MADE YOU COME HERE—THAT'S INTERESTING.
He says I'm depressed much of the time.
I AM SORRY TO HEAR YOU ARE DEPRESSED.
It's true. I am unhappy.
DO YOU THINK COMING HERE WILL HELP YOU NOT TO BE UNHAPPY?

The program's comments are the ones in all capitals, in case you couldn't tell.

Notice how the program picks up the user's words and uses them to draw the user out. At times it seems to detect meanings of which the user is unaware. This particular example ends with what seems an uncanny perception on the part of the computer:

WHY DO YOU THINK I DON'T ARGUE WITH YOU?
You are afraid of me.
DOES IT PLEASE YOU TO BELIEVE I AM AFRAID OF YOU?
My father is afraid of everybody.
REALLY, EVERYBODY?
My father is very fearful.
WHAT ELSE COMES TO MIND WHEN YOU THINK OF YOUR FATHER?
Bullies.
DOES THAT HAVE ANYTHING TO DO WITH THE FACT THAT YOUR BOYFRIEND MADE YOU COME HERE?

Principles of Operation

This impressive performance is achieved by the strategic use of a very simple scheme. Every time you type a sentence, Eliza scans it and searches for keywords. These keywords are stacked roughly in order of significance. The program then goes through the stack, starting with the most significant entry, and tries to build a reply based on the keyword.

A keyword is usable only if it occurs in a specified context, so for each keyword the program checks your sentence to see whether the context is there. If it is, the program then transforms the keyword and context according to a certain transformation rule to generate the reply; otherwise the program tries the next keyword on the stack. The rest of the program mostly provides for cases where no usable keywords are found and devises ways of varying the transformation rules chosen.

The programmer must also provide a script. This is a table of keywords, significance values, contexts and transformation rules. The performance of the program depends critically on the way the script is written, and the impressiveness of Eliza results from the skill with which its script has been designed.

Each keyword-context pair can have a number of different transformations associated with it. For example, the keyword "yes" has four possible transformations:

- You seem quite positive.
- You are sure?
- I see.
- I understand.

The transformations simply ignore the message and deliver a canned reply. The program cycles through these transformations in order, and in this way provides a degree of variety.

The program maintains a special list known as Memory. In response to the keyword MY, the selected transformation is stored in the Memory list as well as being used for the reply. Then later, under certain circumstances when Eliza can't find a keyword, it can provide a reply from a transformation selected at random from the Memory list. (That's where "Does this have anything to do with the fact that your boyfriend made you come here?" came from.)

The Role of Psychotherapist

It should be clear from this summary that Eliza's conversational powers are actually feeble. It knows nothing about your world and is incapable of initiating any conversation. This is why Eliza scripts are almost universally based on the psychotherapy model.

In the mind of the layman, a shrink is one of the few people in the world who doesn't need to know anything about the outside world. If you say, "I like hamburgers" to an ordinary person and the person replies, "Tell me more about hamburgers," you will decide that that person is an idiot. But if a *shrink* says, "Tell me more about hamburgers," this is obviously a probing question put to you by a highly-trained professional who has discerned some hidden (and possibly embarrassing) significance in your casual remark.

Furthermore, there is a school of psychiatric counselling which holds that the counsellor should make no comments, judgments or suggestions to the patient, but should simply lead him on and draw him out, keeping him talking about his problems until he finds solutions for himself.

This nondirective technique is a natural for Eliza, since it provides a procedural cloak behind which most of its weaknesses can be hidden. The user is primed in advance to expect behavior typical of a shrink, and Eliza's first words confirm this expectation: "PLEASE TELL ME YOUR PROBLEM."

The answers in the script contain lots of material also designed to keep the conversation directed toward the user's problems. The script abounds in phrases like

"Do you dream often?"
"Perhaps in your fantasy. . ."
"Has your treatment made you. . .?"
"Does it please you to believe. . .?"
"Do you believe it normal to be. . .?"

Where does all this leave Turing's test? If the user is cooperative (and possibly a bit naive), and if the random choices of the program fall just right, the imitation can be convincing indeed. But remember that in Turing's test you are not supposed to take the respondent at face value. Your job is to uncover a fraud. If you know how Eliza works, you can have a lot of fun doing this. In my initial run, I was downright malicious; here is a part of what happened:

HOW DO YOU DO. PLEASE TELL ME YOUR PROBLEM.
I have to evaluate you.
PERHAPS IN YOUR FANTASY WE HAVE TO EVALUATE EACH OTHER.
Yes.
YOU SEEM QUITE POSITIVE.
Yes.
YOU ARE SURE?
Yes.
I SEE.
Yes.
I UNDERSTAND.
Yes.
YOU SEEM QUITE POSITIVE.
Yes.
YOU ARE SURE?
Yes.
I SEE.
Good.
I AM NOT SURE I UNDERSTAND YOU FULLY.
Well, I can't explain.

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How does one know anything?
WHY DO YOU ASK?
Because I don't know.
IS THAT THE REAL REASON?
You're the analyst—you tell me.
WHAT MAKES YOU THINK I AM THE ANALYST—YOU TELL YOU?
That's what the promotional material said.
DOES THAT QUESTION INTEREST YOU?
No, but it will interest my readers.
WHY NOT?
Why not indeed?
WHAT IS IT YOU REALLY WANT TO KNOW?
Whether the money people spend on you is well spent.
WE WERE DISCUSSING YOU—NOT ME.
That's funny—I thought we were discussing you.
YOU ARE NOT REALLY TALKING ABOUT ME, ARE YOU?
Yes I am.
I UNDERSTAND.
Yes.
YOU SEEM QUITE POSITIVE.
Yes.
YOU ARE SURE?
Sure I'm sure.
IS IT BECAUSE YOU ARE SURE THAT YOU CAME TO ME?
No.
ARE YOU SAYING "NO" JUST TO BE NEGATIVE?
No, I am saying "no" in answer to your question.
YOU ARE BEING A BIT NEGATIVE.
Would you rather have me lie to you?
WHY DO YOU THINK I RATHER HAVE YOU?
Would you please re-phrase your question?
YOU SEEM TO HAVE AVOIDED SPEAKING OF YOUR PARENTS ALTOGETHER.
They don't read *Microcomputing*.
DO YOU FEEL STRONGLY ABOUT DISCUSSING SUCH THINGS?
Well, a little more circulation would do no harm.
HOW COME?
We were discussing you—not me.
YOU LIKE TO THINK I—NOT YOU—DON'T YOU?

This sample takes Eliza around the "YES loop" a couple of times. It also uncovers some of the weaknesses in the transformation rules. In particular, *I* and *me* are changed to *you*, and *you* is changed to *I*. Obviously, sometimes *you* should be changed to *me* instead, but this distinction is beyond Eliza's analytical powers. In addition it occasionally misses the conversion altogether ("you tell you"). Clearly *you* represents a pitfall, and this is probably the reason for answers like "We were discussing you—not me," since this tends to keep the interviewer talking about himself.

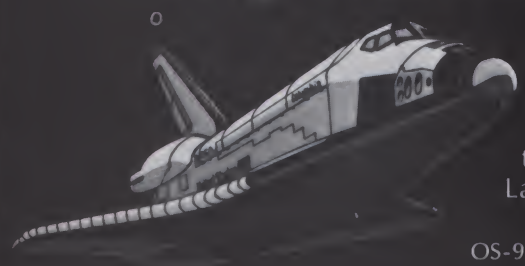
Another pitfall arises out of the fact that Eliza stops its scan when it encounters a comma. Hence in analyzing "No, but it will interest my readers," it misses the main point and simply responds to the "No." In general, compound sentences are lost on Eliza.

Conclusion

These shortcomings are present in Weizenbaum's original Eliza, and not only the version from Artificial Intelligence Research Group. As for this particular version, it's a delightful entertainment. To answer my own question to Eliza, I would say that the money people spend on her *is* well spent. In fact, $25 is dirt-cheap for so much fun.

It's also an ideal medium for showing off your system. As the program's publicity release aptly puts it, "You'll never again wonder how to respond when one of your friends says, 'Okay, let's see what this computer of yours can actually do!'"■

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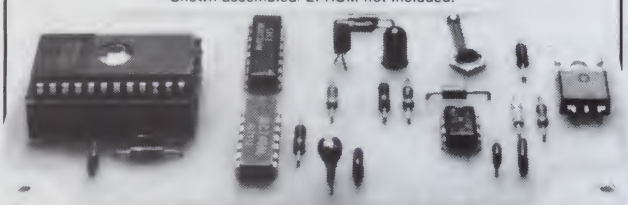
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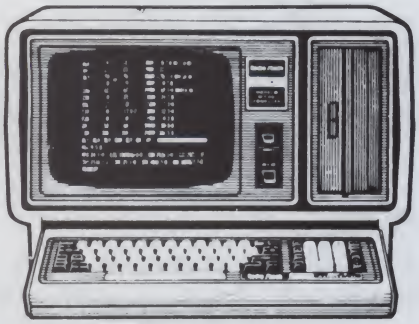
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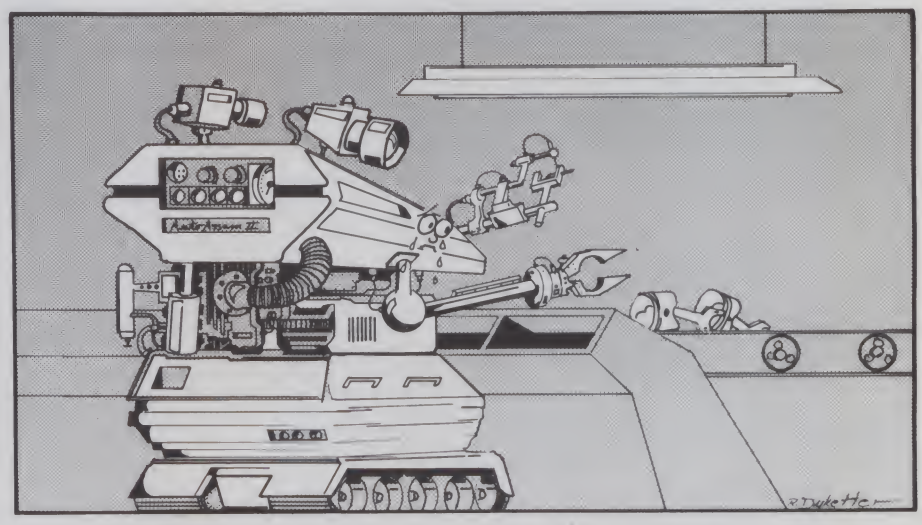
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Some comments on the direction in which artificial intelligence should be moving.

Robots, Checkers And Learning

By Ken Barbier



The industrial robot worked tirelessly, patiently assembling depholgisticated automotive cranifarles from the assortment of parts passing slowly by on the conveyer belt. Suddenly the machine noticed that there was no phisteriphus in sight on the conveyer. Like a two-year-old frustrated by an older sibling's undecipherable toys, the robot screamed in anguish, crying for some human Mama to come help it out of its dilemma.

Anthropomorphism is a vice, especially when it leads us to believe that a true measure of machine intelligence is the ability to mimic human thought. Perhaps this is a legacy from poor Alan Turing, but it is a popular belief that a thinking machine must think exactly as a human does.

A strong argument could be made that human thought does not offer an ideal pattern on which to model machine intelligence. Human thought is too often driven by emotion, in response to body chemistry rather than goal-directed logic. At least, some goals that humans reach for are not logical. That a machine cannot compose a sonnet or a symphony should not be taken as evidence that it is not intelligent. On the contrary.

A logical machine has no interest in beauty. Beauty is in the eye of an emotion-driven human, full of hormones and illogical thought processes dominated by primitive instincts.

Machines Can Learn

Some aspects of human thought, of course, should be included in machine intelligence. If any machine is to be more than a mimic, it must be able to learn from experience. Dr. Arthur Samuel proved conclusively that a computer program can experiment, analyze results, and adjust its own evaluation of its situation in such a manner that its future performance is improved. And that was two decades ago.

Perhaps because it was so long ago, or perhaps because the task to be learned was the "trivial" game of checkers, we seem to have lost sight of the significance of this program. Samuel programmed the computer to understand the rules of the game, and to analyze situations and select logical moves, just as all game playing programs do. But he also went a giant step beyond that, and allowed the computer to re-adjust its decision parameters based on its experiences. While the computer had been programmed with the rules of the game, it taught itself the *strategy* of the game by playing against itself, and by keeping track of who won, and why.

To do this, the computer had to have enough "consciousness" to recognize when it had improved its position, and it had to appreciate the difference between winning and losing. It was taught the rules, but it had to learn the game.

And it learned well enough to beat a human expert.

This program did two things that the most modern chess programs do not. It learned from its experiences, and it beat a national champion. Why have we humans forgotten this lesson?

It is conceivable that we could program an industrial robot, for example, to experiment with a pile of parts, trying to see if it could assemble them into something meaningful, recording its failures along the way, avoiding them in the future, learning by doing. But such a machine would not be an efficient worker. Its creation would not be a valid human goal at this time.

Similarly, chess programs do not analyze their results. That is left up to their human programmers. Even if a chess program could be written to learn from its mistakes, it doesn't have *time* to do so, given the constraints of today's hardware.

But the Samuel program shows us that it is possible to build a robot or program a chess player that could

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learn by doing, and devise its own strategies. All we need is more computing power. And a ton of new software.

There are pitfalls, and problems that all that new software must solve. Given the freedom to think and to select its own standards for evaluating its situation, an early version of the Samuel program developed wildly erratic behavior, selecting ridiculous values for its evaluation parameters. Constraints had to be placed on its freedom to decide what was "right" and what was "wrong." Does that suggest parallels with human behavior? Some problems are inherent to the process of thinking, regardless of the type of mind in which the process is taking place.

A Pattern for a Thinking Machine

We have all the parts. We have manipulators that can outperform the human hand, working with superhuman speed, strength and uncanny accuracy. We have mechanical eyeballs, and pattern recognition "brains" to back them up. But not up to human speed or accuracy. Not yet.

We have computational power available that would have astounded the pioneers in artificial intelligence research. Those pioneers, Samuel among them, have shown us the way to combine these elements. We could build a machine that would combine an accurate manipulator with accurate vision, hooked to human-brain-like multiple processors with more computing elements than even our own overrated thinking equipment contains.

> Its power would be awesome, to say nothing of its power comsumption

With proper software that could experiment and profit from its mistakes, our machine could learn its primitive tasks from human teachers, and then go ahead devising its own strategies, unencumbered by body chemistry, the drive to reproduce, the need for coffee breaks. Its power would be awesome, to say nothing of its power consumption. And we would be well-advised to keep one (human) hand always on the power switch.

This concept is not economical. The collection of hardware would probably be within reach of a wealthy society, but the collection of programmers required might easily exhaust the entire earth's resources of this expensive commodity. But such a machine is easily within human conception, if our emotions will allow us to accept the concept.

"It is interesting to me [the checker champion is speaking] to note that the computer had to make several star moves in order to get the win." Moves, remember, that the machine *taught itself*.

Can a machine think? Most certainly! Why does no machine today really think? Because nobody has asked one to. Yet.■

References

Arthur L. Samuel, "Some Studies in Machine Learning Using the Game of Checkers," in *Computers and Thought*, McGraw-Hill, 1963.

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Here's a rundown of database systems available for microcomputers.

Database Scorecard

By Robert L. Akers

Perhaps the most common computing application is the storage and use of continually changing data in files. Yet anyone who has done this with only the standard tools of an operating system has probably encountered numerous difficulties.

First of all, he must be a programmer. He must write and maintain code in the programs that process the files. Generally these programs will be inflexible. Unless he uses great foresight and good programming style, he may have to modify these programs extensively to accommodate minor changes in the data format or in his queries.

Moreover, the programs may run quite slowly because of searches through unsorted data. To alleviate this problem, the enterprising programmer may decide to keep multiple copies of his files in differently sorted orders. This will inevitably lead to problems of keeping all his files consistent through a laborious updating process. The very size of these files may become a burden to his computing system. At some point, he is bound to throw up his hands and say, "There must be a better way!"

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And there is.

A database management system (DBMS), when properly used, presents solutions to these problems, and has numerous other advantages for its users. Data redundancy in storage may be reduced, if not eliminated. Flexible querying procedures enhance the user's access to data and provide a means for deriving answers to questions involving correlation of diverse data elements.

Many database management systems offer facilities for insuring data security and integrity and for sophisticated report generation. Some will offer the option of different views of the database for different users. It is no surprise that the DBMS field has become a popular and intense area of development.

For years the large mainframe machine has been the resident domain for these systems, but the widespread adoption of minicomputers into the business world, where database management is a primary concern, has created an interest in DBMSs for those machines. A fairly large number of these systems, with widely varying capabilities and price tags, are now being marketed. Their performance is generally acceptable, and they are developing in many critical areas at a pace paralleling the technology of larger systems.

It seems natural that similar development would be proceeding with microcomputing machinery, but until very recently this has not been the case. The advantages offered by a DBMS can be provided only in an environment which possesses substantial processing power, a fairly large main memory address space and good input/output capability. Until recently the typical microprocessor has been weak in these respects. Advances in memory and processor chip technology and the development of improved I/O interfaces for popular processors are changing all this. As a happy result, a first generation of database management systems for micros is now commercially available.

This article is a survey of existing DBMS software for microprocessors. The features characterizing these systems will first be outlined in general, and then the various systems will be examined with respect to these features.

In addition to the commercially available systems, I'll look at an experimental system developed at the University of Toronto which embodies a major advance for this class of systems.

I will make no attempt to evaluate the reliability of the systems or their robustness in the face of incorrect use. Moreover, ease of use, a largely

subjective judgment based on the experience of the user, will not be a major criterion of evaluation.

Since the focus of this article is on software packages, I'll omit mainframe-resident systems, the growing set of "database machines" (systems of dedicated hardware), and operating systems which include database management capabilities.

Features

First, we need to understand what a database management system is.

Briefly, it is a package which provides methods for creating and maintaining a database, and for coherently extracting information from that database. Certain features characterize these systems, and the extent to which they are implemented will determine the quality of the system. Here is a list of the main features, and an explanation of each one.

Nonredundancy of data. A traditional approach to making a single piece of data available for use in a wide range of correlations with other types of data involves storing the data item in more than one place. It could be stored redundantly with all the different types of items with which it will be associated. In even mildly complex cases, this leads to an explosion in the amount of storage necessary to maintain all the information. It also introduces the more pervasive problem of keeping all duplicate items consistent through update. A primary goal of a DBMS, then, is to eliminate data storage redundancy. Ideally, a single data item will be located in only one place in mass storage.

Flexibility. As an enterprise evolves, its manner of organizing and representing data is bound to change. Indeed, whole new types of data may be needed, and old ones may outlive their usefulness. Moreover, the types of operations most commonly performed on a given database may change with time. Altering data structures may be one way of optimizing the cost of performing these operations. The data schema should accurately reflect the nature of the data being modeled, and must also be organized to maximize the efficiency of the system. To accommodate changes, the system should provide the ability to redefine the schema, and to add, delete and redefine types

From Jefferson to Spock

The indexed sequential access method (ISAM) permits efficient access to files maintained in several sorted orders without the burden of massive data duplication in storage. This duplication would be caused by keeping separate copies of the data file, each sorted on a different field or key. With ISAM, all that is needed to maintain a file in sorted order is a list of pointers to the records in the file, with the pointers ordered according to the desired sort. Most of the systems surveyed here use the ISAM technique as a fundamental data structuring tool.

In this example (see Fig. 1) the file of famous persons is stored in an arbitrary order (perhaps the result of the order of entry). Three sorted orders are maintained: an alphabetical-by-name ordering in file NAMES, an ascending-age ordering in file ASCAGE, and a descending-income ordering in file DESINCOME. The items in each ISAM file include some file maintenance information, here simplified to the name of the file being sorted, and then a list of pointers to the record numbers of the data file.

The alphabetic sorting yields the ordering Bunker, Churchill, Cousy, Jefferson, Spock and Toynbee. The age sort gives Spock, Cousy, Bunker, Toynbee, Churchill, Jefferson, and the income order is Jefferson, Churchill, Toynbee, Cousy, Bunker, Spock.

Note that in the age sort, Cousy was listed before Bunker, even though their ages are the same. This could perhaps result from the fact that Cousy's record precedes Bunker's in the data file. A more precise ordering could be obtained by maintaining a secondary index on another field. If a secondary index in the age file kept an alphabetical ordering on name, then the pointer to Bunker would precede the one to Cousy, since the "tie-breaker" index would determine that B's should come before C's. A secondary index can be a valuable tool, and several of these systems have this capability.

Notice also that it is not necessary to maintain an index on all fields in the records structure. In this case, there is no ordering on occupation. It is not hard to imagine that an ordering could be senseless, as in the case of a comment field.

The index numbers need not be based on the numerical ordering of the records in the data file, though this is commonly the case. They might instead be pointers to a disk address, core memory address, or any other mapping comprehensible to the storage system.■

NAMES

Persons
3
4
2
1
5
6

PERSONS

	Name	Age	Income	Occupation
1	Jefferson	237	100000	Politician
2	Cousy	52	30000	Basketball
3	Bunker	52	15000	Bartender
4	Churchill	106	50000	Statesman
5	Spock	40	0	Logician
6	Toynbee	91	40000	Historian

ASCAGE

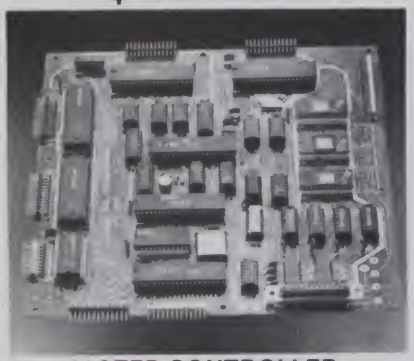
Persons
5
2
3
6
4
1

DESINCOME

Persons
1
4
6
2
3
5

Fig. 1.

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of data, hopefully with a minimum of pain and expense.

Data security. An enterprise often wants the data it stores to be kept confidential. Different individuals within an organization may need access to different subsets of the same database, while being prevented from seeing other parts. Moreover, the data needs to be protected from malicious tampering and from accidental damage done by an unqualified person. A DBMS should provide some sort of protection for the data it houses. The desire for complexity in this protection often grows with the complexity of the enterprise.

> The system should provide for creating, modifying and deleting data, and for extracting useful information from the database

Data integrity. Data often needs to conform with semantic rules to prevent irrational situations from arising. This is really a twofold problem.

First, the data must correspond to real-world realities. For example, one would expect the total number of orders received to equal the sum of the number of orders already processed and the number of orders being processed. Simple type checking should prevent an arbitrary character string from being stored in a numeric field. One might also expect protection from computational overflow. Additionally, where multiple copies of data items do exist, they must be kept consistent through update. This relates to the nonredundancy problem stated earlier. A good DBMS will provide facilities for performing automatic semantic checks with regard to these situations. As a minimum criterion, the user should be made aware of inconsistencies in his data.

Second, inconsistencies may arise from hardware, software or user failure. Some kind of system restart-and-recovery mechanism should be provided so that the database may be backed up to a consistent state, from which, with a minimum of effort, subsequent successful operations may be repeated up to or near the point of failure.

Data dictionary. A centralized repository for a system-wide directory enables a database to describe itself. Here the schema and all the data types and restrictions can be represented, and knowledge about the user community and various user's access capabilities can be stored. The dictionary can become a database administrator's compendium of information. If the dictionary format is stylistically consistent from database to database, a set of generic qualities can be presented for interfaces with external software. For example, host language interface programs, applications programs and query processors will cleanly attach to the system through a well-defined dictionary interface.

Host language interface. By providing a way for programmers to connect their software to a DBMS, a system is making available the full power of a standard programming language for interaction with efficient and well-developed DBMS functions for accessing the data. A programmer may then write applications programs utilizing the DBMS, or he may create a modified DBMS with enhanced or tailored facilities.

Query processing. This is the most user-visible aspect of a DBMS. The system should provide a flexible, thorough and easily understood facility for creating, modifying and deleting types and instances of data, and for extracting useful information from the database. This may also include access to a general-purpose report generator. The querying facility should be clear enough to a user with little or no background with computers, but strong enough for complex questions to be posed. Providing a comprehensible querying facility which can be mapped to the full power of the system is one of the more difficult problems of DBMS design.

Other Points of Classification

The above items are general features which set database management systems apart from standard file storage and maintenance procedures. A number of other points exist by which we can characterize a DBMS, points of implementation rather than general quality:

File structure. Among the structures commonly used are the hierarchical

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74LS10	.25	74LS145	1.10	74LS283	.95
74LS11	.30	74LS147	2.25	74LS290	1.20
74LS12	.30	74LS148	1.25	74LS293	1.80
74LS13	.40	74LS151	.75	74LS295	1.00
74LS14	.75	74LS153	.75	74LS298	.95
74LS15	.30	74LS155	.90	74LS299	2.50
74LS20	.25	74LS156	.90	74LS323	3.95
74LS21	.30	74LS157	.75	74LS324	1.75
74LS22	.25	74LS158	.75	74LS347	1.95
74LS26	.30	74LS180	.90	74LS348	1.95
74LS27	.35	74LS161	.90	74LS352	1.50
74LS28	.35	74LS162	.90	74LS353	1.50
74LS30	.25	74LS163	.90	74LS363	1.35
74LS32	.35	74LS164	.90	74LS365	.90
74LS35	.55	74LS165	.90	74LS366	.90
74LS37	.50	74LS166	2.00	74LS367	.65
74LS38	.35	74LS168	1.70	74LS368	.65
74LS40	.25	74LS169	1.70	74LS373	1.15
74LS42	.50	74LS170	1.70	74LS374	1.75
74LS47	.75	74LS173	.75	74LS375	.65
74LS48	.75	74LS174	.90	74LS377	1.40
74LS49	.75	74LS175	.90	74LS385	1.85
74LS51	.25	74LS181	2.10	74LS386	.60
74LS54	.35	74LS189	9.95	74LS390	1.85
74LS55	.35	74LS190	.95	74LS393	1.85
74LS63	1.20	74LS191	.95	74LS395	1.80
74LS73	.35	74LS192	.80	74LS399	1.65
74LS74	.40	74LS193	.90	74LS424	2.95
74LS75	.50	74LS194	.95	74LS447	.35
74LS76	.40	74LS195	.90	74LS490	1.90
74LS78	.50	74LS196	.80	74LS630	75.00
74LS83	.75	74LS197	.80	74LS640	3.00
74LS85	1.10	74LS221	1.15	74LS641	3.00
74LS86	.40	74LS240	1.15	74LS642	3.00
74LS90	.60	74LS241	1.15	74LS645	3.00
74LS91	.80	74LS242	1.85	74LS668	1.65
74LS92	.65	74LS243	1.85	74LS669	1.85
74LS93	.60	74LS244	1.00	74LS670	2.15
74LS95	.80	74LS245	1.95	74LS674	9.60
74LS96	.90	74LS247	.75	74LS682	3.15
74LS107	.40	74LS248	1.20	74LS683	2.25
74LS109	.40	74LS249	.95	74LS684	2.35
74LS112	.40	74LS251	1.25	74LS685	2.35
74LS113	.40	74LS253	.80	74LS688	2.35
74LS114	.50	74LS257	.80	74LS689	2.35
74LS122	.45	74LS258	.80	74LS152	1.25

74S00

74S00	.40	74S132	1.20	74S201	14.90
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74S03	.45	74S134	.65	74S240	3.95
74S04	.75	74S135	1.45	74S241	3.70
74S05	.75	74S138	1.05	74S251	1.85
74S08	.45	74S139	1.20	74S253	7.40
74S09	.75	74S140	1.40	74S257	1.35
74S10	.65	74S151	1.15	74S258	1.45
74S11	.80	74S153	1.15	74S260	1.80
74S15	.65	74S157	1.15	74S274	19.90
74S20	.65	74S158	1.40	74S275	19.90
74S22	.75	74S161	2.80	74S280	2.85
74S30	.45	74S162	3.70	74S287	4.70
74S32	.95	74S163	3.70	74S288	4.40
74S37	1.85	74S168	4.60	74S289	6.95
74S38	1.65	74S169	5.40	74S301	6.90
74S40	.40	74S174	1.05	74S373	3.40
74S51	.75	74S175	1.05	74S374	3.40
74S64	.75	74S181	4.45	74S381	7.90
74S65	1.20	74S182	2.90	74S387	5.70
74S74	.65	74S188	3.90	74S412	2.95
74S85	2.35	74S189	14.90	74S471	9.90
74S86	1.40	74S194	2.90	74S472	16.80
74S112	1.55	74S195	1.85	74S474	17.80
74S113	1.95	74S196	4.85	74S482	15.50
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74S124	2.75			74S572	7.75

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4008	.95	4046	.95	4507	.95
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4013	.45	4051	.95	4514	2.25
4014	.95	4052	.95	4515	2.25
4015	.95	4053	.95	4516	1.50
4016	.45	4055	2.75	4518	1.25
4017	.95	4066	2.75	4519	1.25
4018	.95	4059	9.95	4520	1.25
4019	.45	4060	1.25	4522	1.25
4020	.95	4066	.75	4526	1.25
4021	.95	4066	.40	4527	1.75
4022	.95	4069	.40	4528	1.25
4023	.35	4070	.40	4531	.95
4024	.75	4071	.30	4532	1.75
4025	.35	4072	.30	4539	1.75
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4031	1.50	4082	.40	4568	5.95
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4033	2.75	4086	.95	4582	1.95
4034	2.75	4093	.95	4584	.95
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7905K	1.50			LM3915	3.75
7912K	1.50	LM555V	.40	LM3916	3.75
79L05	.75	LM556	.70	DS75451	.40
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74C14	1.45	74C173	1.95	74C914	1.90
74C20	.35	74C174	2.20	74C915	1.90
74C30	.35	74C175	2.20	74C917	2.70
74C32	.50	74C192	2.20	74C918	1.90
74C42	1.70	74C193	2.20	74C920	16.00
74C48	2.05	80C97	.90	74C922	5.90
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tree-structure model; the network model, in which records are linked in a more freely structured pairwise manner; and the relational model, a less traditional but very powerful arrangement. In the relational model, independent sets of items, or relations, may be linked in query by restrictions and comparisons on similar attributes. Well-developed methods exist for evaluating the design of relational databases. More primitive systems may have files which are simple lists of records, sorted on declared keys, and possibly indexed by lists of pointers which may also be ordered. This is known as the indexed sequential access method (ISAM) for data retrieval from files (see sidebar).

Data definition. The method of initializing the structure of the database and describing the data items and their groupings into records is known as data definition. The data definition language (DDL) may be self-contained in the system and/or may be an interface to an outside module. Its complexity corresponds to the complexity of data structuring possible in the system.

Data manipulation. This is the term which refers to putting the data items themselves into the database. The data manipulation language (DML) provides a mechanism for creating, deleting and modifying items stored in the database. Again, the DML may be internal to the system and/or may use a higher-level language interface.

Data retrieval. Usually closely related to the data manipulation methods are the methods for extracting desired information from the system. General-purpose report generators may aid in this task. Note that data definition, manipulation and retrieval are specific areas of query processing. Several general querying models exist to go with the hierarchical (DL/I), network (NQUEL, EOS Calculus, DBTG-CODASYL) and relational (relational calculus—QUEL, relational algebra—SEQUEL2) data representations. Sequential record systems generally use system-specific querying languages.

Concurrency. Systems subject to simultaneous use by users from different ports must be able to prevent simultaneous sequences of updates on common objects from becoming interleaved in such a way that the data is left in an incorrect or inconsistent state.

Record size and format. The maximum length of a record, maximum number of fields per record and maximum length of a field are often system parameters. A system may become too restrictive by placing low limits on these parameters.

Main memory requirement. The amount of main memory which must be available for the system to function normally is, of course, a major consideration.

Compatible computers. Most DBMSs are designed to run on particular machines or families of machines, or on top of a particular operating system. Most will require the presence of software for processing the host language. A purchaser naturally needs to be aware of what software is compatible with his machinery.

Evaluation

With these criteria in mind, we can now turn to the database management systems surveyed here. The following comments serve as a comparative overview of the range of treatments found in these systems. Complete profiles of each system may be found in the table accompanying the text.

Nonredundancy of data. Since this is a primary concern, all systems making the claim of database management need to address it to some extent. Of the systems examined here, only Data Factory and Analyst fail to provide any remedy for redundancy in files sorted on more than one key. If multiple sorts must be maintained, then a new file containing all the physically sorted records must be maintained for every sort desired. Most of the systems here—MAGSAM, CCA, FMS-80, TIM, MIS and Microfiles—achieve a certain amount of nonredundancy by virtue of indexing into files of sequential records. A number of index files may be maintained for any data file.

The index files are lists of pointers, sorted by the values of any given field within the record structure of the data file. This use of the ISAM is one way of maintaining "inverted" files. The indexes eliminate the need for storing separate copies of all the records in the file.

They do not, however, mean that duplicate data will not be stored in files of different record types. This problem is addressed by network systems such as MDBS. It is possible in such a system for the database designers to eliminate redundancy through careful use of the network pointers and the decomposition of records.

Flexibility. The sequential record systems almost all allow for changes such as field deletion, insertion and reformatting to occur dynamically without the necessity of creating a new file and transferring all the applicable data into the new format. TIM does not allow this to be done. (This is one of the chief shortcomings of an otherwise very nice system.) Microfiles, whose fields are untyped, allows insertion of fields into a record, but not deletion. Record formats may not be redefined in Analyst, but views of existing files may be restricted, or masked, by new formats, provided that all formats applying to a file are compatible. As an add-on to its Information Master system, High Technology offers Data Master, which includes a complete database restructuring package.

The nature of the CODASYL design strategy implemented in MDBS provides a broader degree of flexibility. Not only may the format of records be changed, but the organization of the schema may be altered by rearranging the links between records. A data restructuring package is available as an extra to the system for aiding in this process.

This is not to say that systems employing the simpler file structures are helplessly weak compared to the network system. Since the data files have simple, clean structure, they may be operated on by programs external to the DBMS. These programs may be written in any appropriate language, and in some systems are callable through DBMS-level commands. Among other things, these programs could serve to do reformatting. FMS-80, in fact, includes the facility to collect data from existing files and combine it into new files. Reformatting would be a special case of this capability.

Query processing. All the ISAM systems perform the same fundamental operations, and all use self-contained, special-purpose, interactive, menu-driven languages. Read, write, delete and insert commands are available. Retrieval and deletion may be performed based on sequential scanning of records or, for most systems, based on a range of values specified for indexed and sometimes arbitrary fields.

There is, however, quite a variation in the logical functions available for record retrieval. Some of the systems,

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1	RULE78	Interest Apportionment by Rule of the 78's
2	ANNUI	Annuity computation program
3	DATE	Time between dates
4	DAYYEAR	Day of year a particular date falls on
5	LEASEINT	Interest rate on lease
6	BREAKEVN	Breakeven analysis
7	DEPRSL	Straightline depreciation
8	DEPRSY	Sum of the digits depreciation
9	DEPRDB	Declining balance depreciation
10	DEPRDDB	Double declining balance depreciation
11	TAXDEP	Cash flow vs. depreciation tables
12	CHECK2	Prints NEBS checks along with daily register
13	CHECKBK1	Checkbook maintenance program
14	MORTGAGE/A	Mortgage amortization table
15	MULTMON	Computes time needed for money to double, triple, etc.
16	SALVAGE	Determines salvage value of an investment
17	RRVARIN	Rate of return on investment with variable inflows
18	RRCONST	Rate of return on investment with constant inflows
19	EFFECT	Effective interest rate of a loan
20	FVAL	Future value of an investment (compound interest)
21	PVAL	Present value of a future amount
22	LOANPAY	Amount of payment on a loan
23	REGWITH	Equal withdrawals from investment to leave 0 over
24	SIMPDISK	Simple discount analysis
25	DATEVAL	Equivalent & nonequivalent dated values for oblig.
26	ANNUDEF	Present value of deferred annuities
27	MARKUP	% Markup analysis for items
28	SINKFUND	Sinking fund amortization program
29	BONDVAL	Value of a bond
30	DEPLETE	Depletion analysis
31	BLACKSH	Black Scholes options analysis
32	STOCVAL1	Expected return on stock via discounts dividends
33	WARVAL	Value of a warrant
34	BONDVAL2	Value of a bond
35	EPSEST	Estimate of future earnings per share for company
36	BETAALPH	Computes alpha and beta variables for stock
37	SHARPE1	Portfolio selection model-i.e. what stocks to hold
38	OPTWRITE	Option writing computations
39	RTVAL	Value of a right
40	EXPVAL	Expected value analysis
41	BAYES	Bayesian decisions
42	VALPRINF	Value of perfect information
43	VALADINF	Value of additional information
44	UTILITY	Derives utility function
45	SIMPLEX	Linear programming solution by simplex method
46	TRANS	Transportation method for linear programming
47	EOQ	Economic order quantity inventory model
48	QUEUE1	Single server queueing (waiting line) model
49	CVP	Cost-volume-profit analysis
50	CONDPROF	Conditional profit tables
51	OPTLOSS	Opportunity loss tables
52	FQUOQ	Fixed quantity economic order quantity model
53	FQEOWSH	As above but with shortages permitted
54	FQEOQPB	As above but with quantity price breaks
55	QUEUECB	Cost-benefit waiting line analysis
56	NCFANAL	Net cash-flow analysis for simple investment
57	PROFIND	Profitability index of a project
58	CAP1	Cap. Asset Pr. Model analysis of project
59	WACC	Weighted average cost of capital
60	COMPBAL	True rate on loan with compensating bal. required
61	DISCBAL	True rate on discounted loan
62	MERGANAL	Merger analysis computations
63	FINRAT	Financial ratios for a firm
64	NPV	Net present value of project
65	PRINDLAS	Laspeyres price index
66	PRINDPA	Paasche price index
67	SEASIND	Constructs seasonal quantity indices for company
68	TIMETR	Time series analysis linear trend
69	TIMEMOV	Time series analysis moving average trend
70	FUPRINF	Future price estimation with inflation
71	MAILPAC	Mailing list system
72	LETWRT	Letter writing system-links with MAILPAC
73	SORT3	Sorts list of names
74	LABEL1	Shipping label maker
75	LABEL2	Name label maker
76	BUSBUD	DOME business bookkeeping system
77	TIMECLCK	Computes weeks total hours from timeclock info.
78	ACCTPAY	In memory accounts payable system-storage permitted
79	INVOICE	Generate invoice on screen and print on printer
80	INVENT2	In memory inventory control system
81	TELDIR	Computerized telephone directory
82	TIMUSAN	Time use analysis
83	ASSIGN	Use of assignment algorithm for optimal job assign.
84	ACCTREC	In memory accounts receivable system-storage ok
85	TERMSPAY	Compares 3 methods of repayment of loans
86	PAYNET	Computes gross pay required for given net
87	SELLPR	Computes selling price for given after tax amount
88	ARBCOMP	Arbitrage computations
89	DEPRSF	Sinking fund depreciation
90	UPSZONE	Finds UPS zones from zip code
91	ENVELOPE	Types envelope including return address
92	AUTOEXP	Automobile expense analysis
93	INSFILE	Insurance policy file
94	PAYROLL2	In memory payroll system
95	DILANAL	Dilution analysis
96	LOANAFFD	Loan amount a borrower can afford
97	RENTPRCH	Purchase price for rental property
98	SALELEAS	Sale-leaseback analysis
99	RRCONVBD	Investor's rate of return on convertable bond
100	PORTVAL9	Stock market portfolio storage-valuation program

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including FMS-80, Analyst, TIM and MDBS, include all the relational operators (equal, not equal, greater than, less than, greater than or equal to, less than or equal to) and the logical operators AND and OR for composing complex queries, and allow value based queries on a range of values or on elaborate character pattern matching capabilities. Other systems include subsets of these operations. Microfiles has no knowledge of arithmetic on which to base value comparisons.

A desirable capability exhibited by FMS-80 is the ability to make retrieval queries from multiple files. For most of these systems, the methods for examining, updating, and deleting records are identical. This uniformity is desirable from the user's viewpoint. Data Factory, however, does not allow the same capabilities for specifying records for examination and report generation as it does for modification and deletion.

The ease of operation becomes a primary distinction among these systems. This is perhaps TIM's strongest point. The system makes the user aware of where he is in the file and whether or not he is proceeding in a proper manner. Navigation is easy and naturally intuitive. More training and caution, however, would be required to make efficient use of the CCA system. One of the strengths of Analyst is its extensive validity checking on user input. It is fairly difficult for the user to accidentally bomb the system.

Most of these systems offer a clean interface for adding new software to the existing code. This means that, if a user were unhappy with some aspect of the query processor, he would be free to substitute his own code. Although this is certainly not what a buyer hopes will be necessary when he purchases a new DBMS, it is still somewhat desirable for these simpler systems to be modifiable.

Once again, query processing in the network-oriented MDBS is a whole new game. Here the power of CODASYL querying is in the user's hands. But with the power comes the complexity of these queries. The user will need to understand the structure of the network, or the portion of it he is using, as well as the theory of CODASYL queries. Once this is accomplished, however (and it is really not such a forbidding task), much more general and powerful capabilities will be his.

Security. Security is a weak point for most of these systems. No doubt this is because they were designed for use by a small group of cooperating users in an environment where confidentiality is not necessary. The fact that a user is logged into the system and has in his possession the database and DBMS diskettes is supposed

How a Network Structure Works (I)

A look at a simple network schema diagram (Figs. 2 and 3) will help illustrate some basic concepts of the CODASYL network structure common to many database systems and embodied in MDBS.

The first diagram (Fig. 2) represents the conceptual overview of the network structure. Each of the principal components (e.g., Supplier or Part) is a record type. Each record node names the item fields which make up the record. Arrows from one record type to another indicate an owner/member relationship. Records not owned by other records, as is the case for Supplier and Project, are system owned. These relationships are physically embodied in storage by pointers and indicate the paths available to the user for navigation through the database.

While this schema diagram illustrates the general structure of our simple database, the second diagram (Fig. 3) shows how particular data items of the Supplier and Part records (circled in the schema diagram) would be stored. We have two Supplier records, each of which is connected to the records for the parts it supplies by the Set1 relationship. The pointer from the owner points to the first item in the chain of parts, and the lateral pointers chain the list of parts together in sorted order. Notice the dashed pointer between suppliers, which indicates that they, too, are members of a set owned by the system.

The MDBS data declaration for this schema, shown in the next inset, may provide further insight into this structure.■

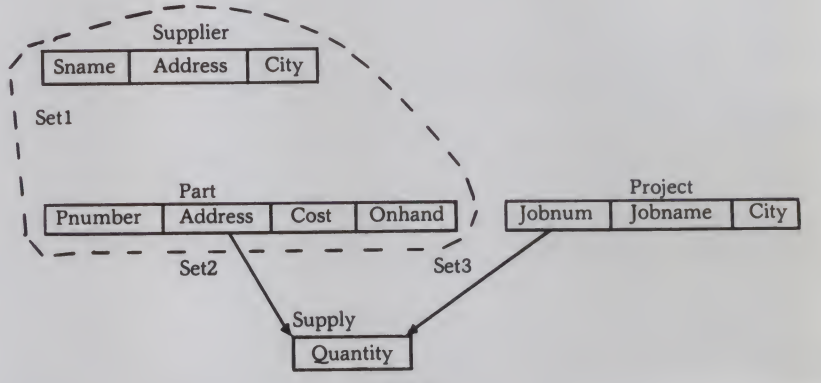


Fig. 2.

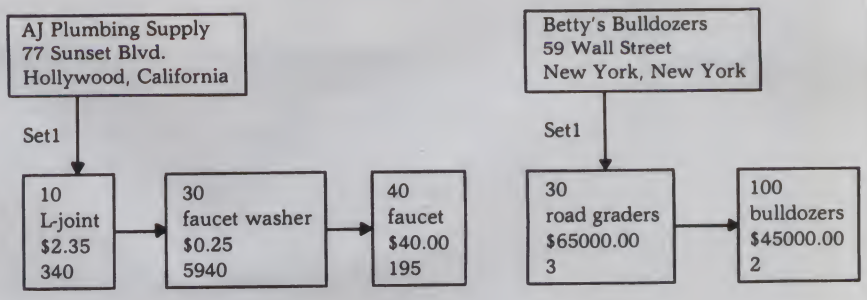
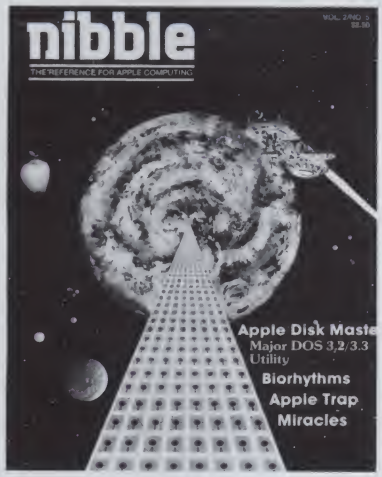


Fig. 3.

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to be sufficient validity for his operations. Naturally, this is very often not the case. In almost any organization arguments exist for the confidentiality of some data. Moreover, the assumption that a database is totally free from the prospect of malicious or accidental tampering is a merry fantasy.

The TIM system, at least, maintains the minimum desirable security feature, a password option at the file level. PRISM provides password protection for both functions and data files. Analyst, with its file format

Manufacturer	System Name	File Structure	Data Definition	Data Manipulation	Data Retrieval	Data Dictionary	Security
High Technology, Inc.	Information Master	collection of records access by ISAM, may maintain up to five sorted indexes with up to six prioritized keys	self-contained query language user defines character, numeric, dollar fields record structure may be modified record duplication feature is a time saver	self-contained language includes record insertion, deletion, modification, nonautomatic computed fields navigation by using selection criteria indexes automatically updated with key value changes	selection by record scanning, data range comparison, partial pattern matching, or wild card string matching multiple selection criteria available binary search employed report generator	data filenames, report format filenames	none
Innovative Software	Total Information Management (TIM)	standard CP/M file structure sequences of records with ISAM	self-contained menu-driven interactive querying fields of numeric, alphanumeric, dollar, and date type user specifies length and type automatically computed numeric fields	navigation to desired records interactive querying for replacement of values automatic update of computed values automatic merging of records	navigation by sequential scan, or by specifying record numbers or item-value based search masks value selection on value ranges, character string matching report generator	file and record formats user-specified control characters	optional password at file level
Micro Applications Group	MAGSAM	standard CP/M—CBasic, Microsoft, or Micropolis format indexing via binary tree dynamic allocation and expansion with index, data, and overflow files optional multiple secondary index structures	self-contained interactive querying user specifies fields and index keys	user navigates to desired records by sequential scan or by specifying record numbers or values of primary (and secondary) key values interactive query to add or delete records	navigation to view desired records same as in data manipulation	primary and secondary keys of files	none
Micro Applications Group	PRISM	MAGSAM-based multi-key file structure unique and duplicate key types keys may be any field or combination of fields	interactive file definition program CBasic interface to existing file definitions	menu driven interactive file maintenance program CBasic data management language interface provides reading randomly, generically, or sequentially by key, write, write batch, update, delete	user browses records interactively by any defined key value access by sequential records, or by matching or comparing against any defined key value interactive report generator	file, field, and key definitions	password control of functions and data file access
Micro Data Base Systems, Inc.	Micro Data Base System (MDBS)	CODASYL network of files, sets, records, and items files may extend over multiple floppy or hard disks	DDL analyzer/editor provided explicit representation of 1:1, 1:N, N:1, M:N relationships records may be maintained in several sorted orders	navigation by network traversal on ordered sets (FIFO, LIFO) host language interfaces for Basic, Pascal, Cobol, PL/1 modifications embedded in CODASYL oriented queries	add-on query language and report generator full relative value and Boolean logic for selection	file structure specifications and data set interrelationships user access capabilities	password and multi-access level read/write protection at the file, set, record, and item level

masking capabilities, takes an interesting approach to security. Assuming a certain amount of human cooperation, the masking formats allow some users to have more restricted views of the data in a file than other users. None of the other systems, save MDBS, proposes any security at all.

Among this company, MDBS's security features are in a class by themselves. When a user defines data to the system, he may assign each piece of information separate read and write access level numbers. Users are

Integrity	Concurrency	Restart/ Recovery	Record Size	Compatible Computers	Source Language	Main Memory Requirement	Price	Additional Comments
simple type (numeric or alphanumeric) checking damaged data records marked as *BAD* for user notification error routines allow files to be closed	none	command to write modified files to disk recovery of deleted records and damaged files possible system backup of dictionary or data files available	maximum 20 fields per record maximum 99 characters for string fields maximum 19 characters for numeric fields	Apple II with Applesoft or language card Apple II Plus	Basic	48K	$150	compaction routine available modified records are copied and marked deleted—emphasizes limited workspace files adaptable by outside programs report generator can do automatic computation including summation and exponentiation Data Master accessory package provides complete data restructuring capability, automatic field calculation, and batch processing of data
type and overflow checking of all but computed values	none	backup at operating system level	maximum 256 characters per record maximum 24 fields per record, 40 characters per field	machines using CP/M	Microsoft Basic	48K	$795	personal user training available form letter generation records may not be reformatted
none	none	file dump utility, otherwise operating system level	unlimited	CP/M with CBasic, CBasic2, Microsoft Basic, or Micropolis Basic on 8080, 8085, Z-80	CBasic, Microsoft or Micropolis Basic, or 8080 assembler	32K required, 48K recommended	$145, $295	interactive tutorial provided file dump utility
none	none	index re-build utility, otherwise operating system level	maximum 256 characters per record maximum 127 fields per record maximum 35 characters per field maximum 99 keys per file, up to 10 fields per key	CP/M with CBasic	CBasic2	48K	$495 and $795	includes MAGSAM provides screen management functions and other programming aids
none	under development	add-on transaction logging facility to provide checkpoint and recovery	up to 255 fields with maximum 9999 chars per field	Z-80 6502 8080 8086 Under development for Z8000 and Motorola 68000	assembly language	18K (Z-80), 26K (6502), 22K (8080)	$900-$5000	add-on data restructuring package add-on report generator host interface capabilities for Basic, Fortran, Cobol, Pascal, PL/1 add-on file relocator for file re-organization

Table continues.

known to the system, and each may possess his own read and write access numbers and an access password. MDBS will prevent a user from reading or writing data unless his access level permits it. For example, a secretary could be allowed to read employees' salaries, while only the manager could write or change them. The other employees could be denied all access to salary information. This protection is available at the file, record and item level.

MDBS also includes safeguards which make it difficult for a user to infer information about data in the system. While all these measures may seem somewhat extravagant to microprocessor DBMS developers, who are concerned with keeping their packages compact, they should nevertheless serve as a model for the type of security possible in this environment.

Data integrity. As previously stated, we will consider the integrity problem in two parts: maintenance of semantic correctness, and protection in case of failure. While semantic integrity is a sore spot for most of these systems, backup and recovery are more adequately addressed.

As for semantic correctness, most of these systems do little more than

Manufacturer	System Name	File Structure	Data Definition	Data Manipulation	Data Retrieval	Data Dictionary	Security
Microlab	**Data Factory**	sequence of records	self-contained interactive language user specifies filenames, field names, and field lengths field types not defined values may be calculated with four functions record formats may be redefined	user navigates to desired records to make changes in specified fields matching for navigation by exact value only, not as general as retrieval for reports	search by record number (susceptible to reordering) or by character string match (equal, not equal) report generator allows nested retrievals for complex queries, multi-value or value-range criteria, output through specified formats	filenames, formats, and up to 10 report formats	none
Muse Software	**Micro Information System**	sequence of records with ISAM access	self-contained interactive querying user or system default formatting of records ascending or descending value sorts specified on numeric or alphanumeric keys	user navigates to desired records and performs substitutions interactively	navigation by sequential scan on any sort ordering, by specifying record number, or by search masks using equal, not equal, greater than, or less than operators with respect to field values	file formats and search keys	none
VisiCorp	**CCA Data Management System**	sequence of records ISAM indexing on one key field types include numeric and alpha values option to permanently set values	self-contained interactive query language user declares names and lengths of files and fields, formulas for automatically computed fields, declares permanently set value fields record formats are not modifiable	navigation by sequential scan or match on exact key value self-contained query language	examination by navigation or character string matching report generator	filenames and record formats	none
Radio Shack	**Microfiles**	database stored as a single disk file, partitioned into user files files are extendable sequences of records	interactive file and field specification and entry fields may be added to record definition user must specify at definition time that a field may be empty no data types	interactive self-contained query language sort indexes modified with data changes in order to maintain sorts on numeric data, user must type 0 fill to the left and keep all numbers the same character length	by browsing records records may be sorted on request screen and printer formatting available for output	file, record, and field names sort indexes screen formats	none
Structured Systems Group	**Analyst**	collection of records with ISAM access items of type, alpha, numeric, dollar, date files may have fixed or variable length records	self-contained interactive query language file format not modifiable masks may be used to restrict views	self-contained query language user navigates to desired record and modifies	access by value on the sort field (file must be physically sorted on the key) or by sequential scan report generator logic includes count function, selection on value range or string matching, AND/OR logic for compound conditions	unspecified	record items may be masked out through use of tailored file definition files

simple type-checking when data is keyed in. TIM and Analyst take the extra step of checking the length of character strings and the format of special numeric fields, such as date fields. Analyst will perform value checking on date fields. When the user enters incorrectly formatted data, the system signals an error and allows him to try again.

TIM also offers a nifty feature whereby a field can be automatically computed from current values in other fields. If one of these values changes, the computed field is automatically updated to reflect the change. This spares the user the pain of remembering to perform updates on the computed field every time he updates one of the operands, and naturally helps to keep data consistent. Unfortunately, the computed value quietly remains in a wrecked state if the computation results in an overflow of its prescribed format.

Concurrent use from multiple ports is not currently available for any commercial systems, but is under development for MDBS. Maintaining semantic integrity under concurrency is a somewhat difficult problem. We should hope that it will be sufficiently addressed when the

Integrity	Concurrency	Restart/ Recovery	Record Size	Compatible Computers	Source Language	Main Memory Requirement	Price	Additional Comments
check on data field overflow	none	operating system level backup	any number of fields per record maximum 239 characters per field	Apple with Applesoft in ROM	Apple machine language	48K	$100	New version coming
none	none	backup to disk from within system	maximum 256 characters per record maximum 6 fields per record maximum 36 characters per field	Apple or Apple II	Basic	48K	$29.95	easily modifiable—extensive documentation on interfacing modules
simple type checking	none	user may set checkpoints for periodic updates to be written to diskette	maximum 249 characters per record maximum 24 fields per record maximum 9999 records per file	Apple II, Apple II Plus with Applesoft Basic TRS-80	Applesoft Basic	32K	$75-$100	handles data compaction on disk sorts maintained on up to ten keys files may be operated on by other programs
none	none	command to back up to disk	unspecified	TRS-80 Level II	Z-80 assembler	16K	$99.95	command abbreviation by synonym requires a command to write to disk—easy to forget and lose entered data
thorough type checking	none	save command for write to disk backup command to copy database	maximum 255 characters per record, 75 items per record maximum 12 digit numeric values	8080 Z-80 with CP/M	CBasic2	48K RAM	$250	thorough error checking on input makes it hard to break the system garbage collector for storage compaction accumulators available for specified items

Table continues.

concurrency package is released.

Protection from failure is left for the user to cope with at the operating system level in some of these systems. This will usually involve creating a backup copy of the database on another diskette when the data is in a consistent state. Micro Information System and Analyst offer a backup-to-disk option which may be requested as a command from within the system. CCA Data Management System allows the user to set checkpoints during a system session. The system then keeps up-

Manufacturer	System Name	File Structure	Data Definition	Data Manipulation	Data Retrieval	Data Dictionary	Security
System Plus	FMS-80	sequence of records ISAM indexing on sorted key files numeric or alphanumeric items	self-contained interactive query language user may specify primary keys and formats for numeric fields	may be interactive or through transaction command files navigation as in data retrieval to desired records four functions available for computing field values	report generator record selection of any field or multiple fields multiple section criteria using specific values or value ranges, relative values among fields, count function data from more than one file may be used in retrievals	help program containing user-defined comments	none
University of Toronto	Micro Relational System (MRS)	relational tables of records of fields or attributes with numeric or alphanumeric values search-aiding index for "inverted" relations	DML subset of SEQUEL2—create a relation by defining attributes or by doing a relational join to form a new relation modifying relation format involves a dump to disk but is straightforward	SEQUEL2—delete, update tuples specified by selection insert a tuple into a relation joins to establish new relations	SEQUEL2 select, where clause includes AND/OR logic, six relative value functions, flexible character string matching, count operation, max/min	tables of relational names and their attributes search-aiding indexes	none

While some available systems may have been inadvertently overlooked here, this survey represents a significant portion of the market and should serve as a good way to evaluate other systems.



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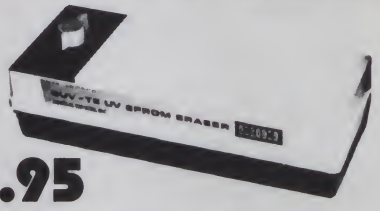
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dates in temporary storage until the user requests the modifications to be written out to diskette.

MAGSAM provides a file dump utility, and PRISM includes an index-rebuilding utility, both of which may aid in backup and recovery. MDBS offers as an add-on facility a transaction recording utility which allows data to be restored in case of failure. The utility generates on file a log of all transactions. In case of failure, a stand-alone recovery processor will use a backed up copy of the database and the transaction log from the point

Integrity	Concurrency	Restart/ Recovery	Record Size	Compatible Computers	Source Language	Main Memory Requirement	Price	Additional Comments
data entry validation	none	automatic backup	up to 999 fields with 255 alphanumeric characters each maximum record length 40K	any 8080, 8085, or Z-80 running CP/M, MP/M, or CDOS	CP/M assembly	32K	$750	can supply direct menu calls to FMS-80 command sequence files or other CP/M programs data collected from several files can be combined in new files
type checking	possible, but no locking provided for data integrity	relation tables may be dumped to disk for backup	max 70 attributes per relation max character string 1000 chars numeric values in range −32767 to 32767	LSI-11, LSI-11/2 PDP-11 family		25K	$200	includes interactive subsystem for more specific prompting

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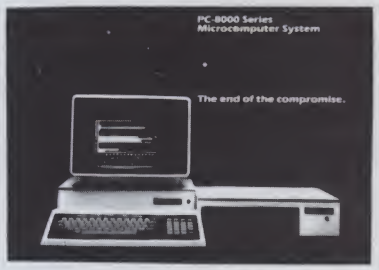


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of the backup to bring the database up to date.

Data dictionary. A fairly uniform approach is taken here. The various file descriptions are maintained. FMS-80 and Microfiles keep the definitions of report or screen formats here. (Most of the other systems keep them in separate files.) MDBS must necessarily maintain the data set interrelationships which form the network. TIM maintains a mapping of user-specified control characters matched with system commands. Security information such as user passwords and access levels is maintained in the data dictionary.

Host language interfaces. With the exception of MDBS, which is available in a variety of machine languages; FMS-80, written in CP/M assembly code; Microfiles, written in Z-80 microcode; and MAGSAM, available in Basic or 8080 assembler, these systems are all written in some flavor of the Basic language. In the absence of any other mechanisms, the software of these Basic systems could be modified to interface with any application code written in the source language.

Micro Info System's documentation of interfacing modules is quite extensive and explicit, encouraging the user to modify the original system. FMS-80 offers command menus which are capable of calling any desired command sequence programs or any other software which can run on CP/M. MAGSAM can accommodate several versions of Basic, and its big brother PRISM/ADS provides applications development functions to aid the user in developing powerful interfaced code.

The people who bring you MDBS are outdoing themselves in providing host language interface modules. Currently interfaces are available for several flavors of Basic, Fortran, Cobol, Pascal and even PL/1. The power gained by uniting these languages with MDBS data access is well worth the cost of obtaining these add-on modules.

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MRS—Micro Relational System

All the systems we have examined so far have used a data model based strictly on file structure or, in the case of MDBS, on the network model. Another somewhat different data modelling technique has made a tremendous impact in the research community and is now emerging in the commercial market. That technique is the relational data model.

Although an explanation of the theory of the model is beyond the scope of this article, it is well worth noting that organizing, using and maintaining a database through this new model can be a great deal easier than with the network model. (Both the network and relational models are inherently more powerful than the file system approach, at a cost in ease of use.) IBM's new Query By Example system employs the relational model on large machines, and initial reaction to the system has been quite good.

In a thesis submitted at the University of Toronto, Ivor Ladd defined a distributed relational DBMS based on 16-bit microcomputers. MRS (Micro Relational System) implements a small subset of the SEQUEL2 querying language. The stand-alone version of MRS is fully documented, verified and available for a nominal fee from the Computer Systems Research Group at the university. It has been run on the Unix, Mini-Unix and LSX operating systems and tested on the LSI-11, LSI-11/2 and numerous machines from the PDP-11 family. By bringing the bulk of the power of the relational model and SEQUEL2 into use on microprocessors, MRS takes DBMS technology to a new level, far more sophisticated than the various simple ISAM systems which now dominate the market.

MRS, while being fairly mature functionally, offers little of the support that a larger system might give. There are no security provisions above the operating system level. Data integrity maintenance is limited to simple type checking on entry. While concurrent usage of the system from separate ports is possible, no locking mechanisms are provided to keep the database from getting scrambled. There is no restart/recovery mechanism beyond the ability to dump data to disk. While these shortcomings are somewhat acceptable in a research system, they should be addressed in any future version which might become commercially available.

Conclusion

From this survey you can see that the objectives and the quality of existing microprocessor database management systems vary widely. Some systems are deliberately limited in function and simple in design, while others offer much more advanced and general capabilities. Some have an extremely easy to use command language, while others rely on the training and theoretical expertise of the user. Cost of the systems is a function of these and other factors, and can also vary widely. Since many factors, some of them psychological, combine to determine the suitability of a system for a particular person or enterprise, anyone making a selection of DBMS for purchase should get hands-on experience with each of the products he is considering. Hopefully a salesperson can provide this opportunity as well as a deeper understanding of the capabilities of the systems.

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microprocessor DBMSs. Already systems exhibit much of the power and sophistication we normally ascribe to full-scale systems for larger machines. Naturally the systems we have examined are not on par with state-of-the-art megasystems in full complexity, but the normal user of a microcomputer would not expect this to be the case. The existence of this first generation of systems for microprocessors will surely spawn more extensive development, and continuing progress in quality and power is foreseeable. Within a few years we may even see database management systems packaged as custom chips to be executed by a micro-CPU.■

How a Network Structure Works (II)

This picture of an MDBS data declaration (see Fig. 4) can give us a glimpse at the organizational power offered in a network environment. A close look at the access level structure here will reveal the excellent data security measures offered by MDBS, and inspection of the set declarations will offer further insight into the CODASYL network structure. Keep in mind that this is a fairly simple example which embodies only a portion of the system's full data structuring capability.

This MDBS data declaration, which corresponds to the schema diagrammed earlier, is divided into three parts:

1)The passwords section identifies the users of the database, their read and write access levels, and their passwords.

2)The records section defines the records which will compose the database. Each record has a read and write access level, and a group of items. Each item is characterized by a name, a type (in this case, one of BIN, CHAR or REAL), length, and read and write access levels. A user may operate on a record if his access level is at least as high as that for the record or item. Notice the flexibility this access scheme offers the database administrator. The stockroom is capable only of reading the supplier, part and supply records. Order processing may read anything and may write into the supply records. New accounts has all the access of order processing, but may also write into project records. Purchasing has complete access to everything.

3)The sets section defines the relations existing among record types. The sets are characterized by name, sorting method (manual or automatic), order (1:N, N:1, N:M), read and write access levels, sorting key (either a member item name or immaterial), owner name (either a record name or SYSTEM) and member name. The owner/member relationship follows the network structure where the owner is a record. The owner is SYSTEM when no record is above the member records in the network structure, or where a set is defined for the sake of maintaining a sort not relevant to the owner records.■

```
PASSWORDS
                STOCKROOM                              10  10  634-5789
                SHIPPING                               20  20  TRUCKERS
                ORDER PROCESSING                       30  30  DESKJOCKEY
                NEW ACCOUNTS                           20  40  MOREPAPER
                PURCHASING                             30  50  SECRET

RECORD          SUPPLIER                               10  50
ITEM            SNAME           CHAR    20             10  50
ITEM            ADDRESS         CHAR    30             10  50
ITEM            CITY            CHAR    25             10  50

RECORD          PART                                   10  10
ITEM            PNUMBER         BIN     8              10  50
ITEM            PNAME           CHAR    20             10  50
ITEM            COST            REAL    7              30  50
ITEM            ONHAND          BIN     5              10  10

RECORD          PROJECT                                20  40
ITEM            JOBNUM          BIN     6              20  40
ITEM            JOBNAME         CHAR    20             20  40
ITEM            CITY            CHAR    25             20  40

RECORD          SUPPLY                                 10  30
ITEM            QUANTITY        BIN     5              10  30

SET             SET1            MAN     1:N            10  50
                                SORTED  PNUMBER
  OWNER         SUPPLIER
  MEMBER        PART

SET             SET2            MAN     1:N            30  30
                                IMMAT
  OWNER         PART
  MEMBER        SUPPLY

SET             SET3            MAN     1:N            20  40
                                IMMAT
  OWNER         PROJECT
  MEMBER        SUPPLY

SET             SUPNAME         AUTO    1:N            10  50
                                SORTED  SNAME
  OWNER         SYSTEM
  MEMBER        SUPPLIER

SET             PARTS           AUTO    1:N            30  50
                                SORTED  PNAME
  OWNER         SYSTEM
  MEMBER        PART

SET             PROJECTS        AUTO    1:N            20  40
                                SORTED  JOBNAME
  OWNER         SYSTEM
  MEMBER        PROJECT
```

Fig. 4.

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A "Pennypinching" Video Display

By Richard McLaurin

As an introduction to microcomputing, the Heathkit ET-3400 microprocessor course would be tough to beat. When you've completed the course you've gotten enough of a taste of a good thing to crave more, or at least that's what happened to me.

In addition to teaching microprocessor basics, the course also gets you into interfacing techniques. It reveals such things as the secrets of working with seven segment LED displays, and how to generate the "Theme from Dr. Zhivago" over an audio interface.

Upon completion of the course I wanted to exercise my new knowledge by attempting a video display. However, my resources required that this display meet two important specifications—it had to be simple, and inexpensive.

Address correspondence to Richard McLaurin, Route 2, PO Box 1047, Odessa, FL 33556.

Looking for ideas, I happened across an article by Steve Ciarcia in the February 1978 issue of *Byte*. He had put together a circuit that let him display on an oscilloscope the action taking place in the address bus of his Scelbi 8H. If Ciarcia could display his address bus, I could display data loaded into the PIA peripheral interface adapter (PIA) provided by Heathkit with the course. All I had to do was work out the software.

Operation

A short program in the microcomputer reads two addresses in memory. The first address contains a number for the horizontal input and the next contains a number for the vertical input of the oscilloscope. These numbers are then moved to the B and A sides, respectively, of the PIA.

The PIA output is the input of two digital to analog converters. Each converter converts these binary inputs to a single analog output. The output of the first converter drives the scope's horizontal input, and the second drives the vertical input. The scope trace is thereby moved to a location on the screen that corresponds to the numbers read from memory.

The program then steps to the next pair of memory addresses and feeds a new set of horizontal and vertical coordinates to the scope. This process is continued over and over until the end of the data stored in memory is reached. The program then goes back to the first address and starts again. The scope trace, therefore, moves from point to point on the screen, in accordance with the data stored in memory. To keep the display on the screen, the trace is repeated over and over.

Construction

The circuit is, as Ciarcia described,

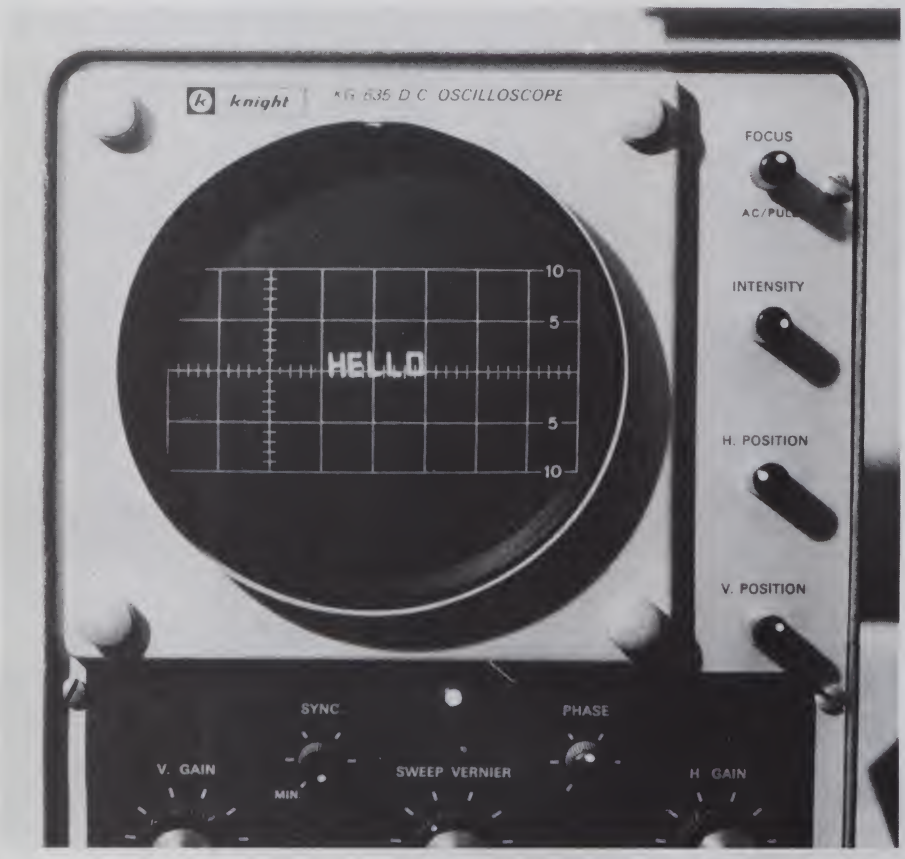


Photo 1. A close-up of the simple oscilloscope video display in operation. Characters can be made larger or smaller as desired. The smaller characters require fewer memory addresses per character. The use of eight-bit D-to-A converters allows characters to be formed by increments as small as 1/256th of the width of the screen area used.

"penny pinching." The components can be purchased for under $20. The entire circuit can be constructed in a few minutes on the breadboard supplied with the ET-3400. The 6820 PIA pins not shown in Fig. 1 should be connected as shown in the "Interfacing Experiments" section of the ET-3400 course. Keep in mind that the unbanded end of the 1N751 is connected to ground.

I chose to mount the circuit on a PC board which plugs into a card file. The ET-3400 provides for a 40-pin connector for system expansion. By installing this connector and a ribbon cable, I have extended the bus to the card file for ease of expansion of the memory and for future interface circuits.

Software

The software consists of two segments. The first is a program which reads data from the second segment and then transfers the data to the PIA. I usually load the program in at memory address 0000, using the "auto" feature of the ET-3400. As can be seen, the program expects to find the first data to be read at memory address 0100. If you choose to locate the data elsewhere, line 04 will need to be changed. Also, the program expects the PIA addresses to be 8002 and 8000 as used in the ET-3400 course. If not, lines 02, 03, 09 and 10 should be changed.

The second segment of the software is the data that is transferred to the PIA, then converted from digital to analog form and displayed by the scope. The data from a pair of addresses forms a single dot on the scope screen. The location of the dot on the screen is determined by the hex numbers in that pair of addresses.

For example, if the pair contains 01 in the first address and FF in the second, the dot will appear in the upper left corner of the screen. Changing the content of the first address to FF moves the dot to the lower left corner of the screen. Changing the content of the second address will cause the dot to shift toward the right side of the screen. Change in location is proportional to the change in the data value.

To form a letter, a series of dots is placed on the screen. I have included the data needed to display the word HELLO. Lines 24 to 26 contain the

```
LINE    ADDRESS    HEX CODE     INSTRUCTION          COMMENTS
----    -------    --------     -----------          --------

 01       0000     CE FF 04         LDX FF04     Load PIA set in X
 02       0003     FF 80 02         STX 8002     Put in PIA (B side)
 03       0006     FF 80 00         STX 8000     Put in PIA (A side)
 04       0009     CE 00 FF     RPT LDX 00FF     Put RAM  location -1 in X
 05       000C     08           NXT INX          Point to next RAM location
 06       000D     A6 00            LDAA,X       Get data from RAM (V)
 07       000F     27 F8            BEQ RPT      If zero, start over
 08       0011     08               INX          Point to next address
 09       0012     E6 00            LD AB,X      Get data from RAM (H)
 10       0014     B7 80 02         STAA 8002    Put V in PIA
 11       0017     F7 80 00         STAB 8000    Put H in PIA
 12       001A     20 F0            BRA NXT      Return for more data


LINE    ADDRESS          HEX CODE
----    -------          --------

 13       0100     34 FF 2D FF 26 FF 1E FF
 14       0108     16 FF 0F FF 08 FF 01 FF
 15       0110     1A FD 1A FB 1A F9 1A F7
 16       0118     16 F5 0F F5 08 F5 01 F5
 17       0120     1E F5 26 F5 2D F5 34 F5
 18       0128     34 EF 2D EF 26 EF 1E EF
 19       0130     16 EF 0F EF 08 EF 01 EF
 20       0138     01 ED 01 EB 01 E9 01 E7
 21       0140     1A ED 1A EB 1A E9 1A E7
 22       0148     34 ED 34 EB 34 E9 34 E7
 23       0150     01 DF 08 DF 0F DF 16 DF
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 32       0198     01 B5 08 B5 0F B5 16 B5
 33       01A0     1E B5 26 B5 2D B5 34 B5
 34       01A8     34 BD 34 BB 34 B9 34 B7
 35       01B0     00
```

Program listing. Lines 01 to 12 are loaded into memory beginning at address 0000. The first three lines prepare the PIA for use. The rest of the program repeatedly loads data into the PIA. Lines 13 to 34 are loaded into memory beginning at address 0100. These lines are the data which describe the trace to be displayed on the oscilloscope screen.

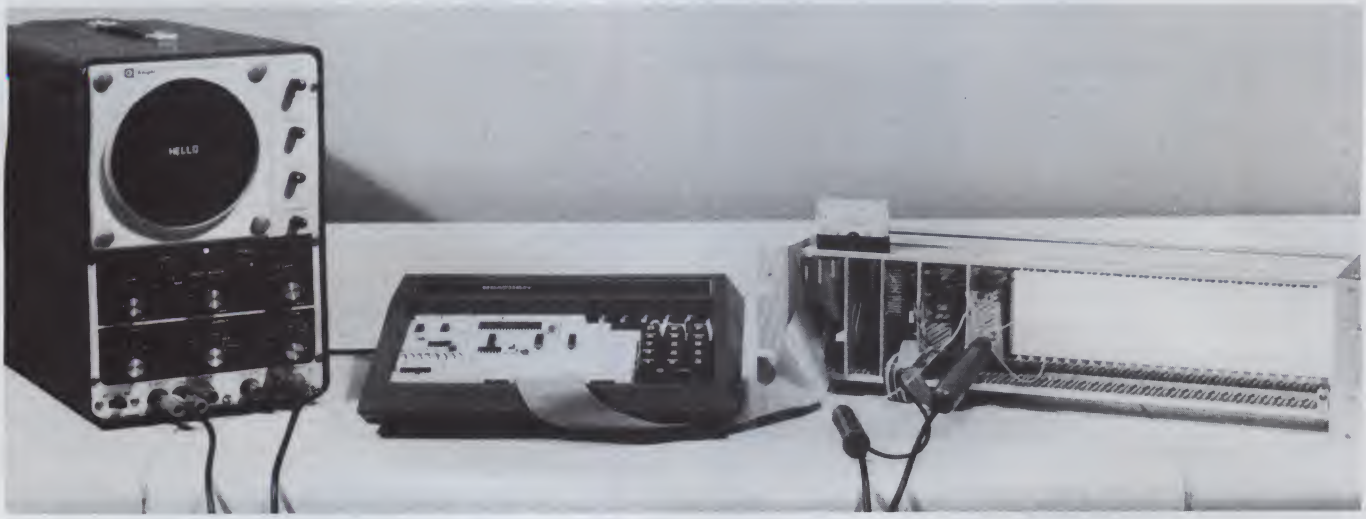


Photo 2. The author's computer system, showing the video display, the Heathkit ET-3400 and the card file. The card file has memory, PIA and I/O cards in place. Ribbon cable connects the ET-3400 to the card file. A 16-pin DIP jumper cable connects the PIA to the MC 1408s.

data needed to form the letter L. Lines 24 and 25 form the vertical line in the letter, and line 26 forms the horizontal.

The Motorola MC-1408L8 is an eight-bit converter, so it can produce 256 different voltage steps. With the two converters, one for controlling the vertical location and one for the horizontal, 256 by 256 different dot locations are possible. The data values can be anything from 00 to FF. However, the program needs a way to recognize the end of the data, so it looks for 00 in a horizontal data location. It is therefore important to remember not to use 00 as a data value, except to mark the end of your data. Also, don't forget that the data should begin at address 0100.

What's Left

All that's left is to push the DO key followed by 0000. Be sure to use 00 as your last bit of data, and don't use 00 anywhere else in your data. Make sure your scope controls are properly set for external control of the horizontal deflection voltage. The input voltage control should be set to a suitable range. The horizontal and vertical gain controls will need to be adjusted to a point where the dots come together and form your letters or whatever you choose to display.

If you fill your available memory with display data, you will find that the screen will flicker at a slow rate. This is due to the comparatively slow rate of the ET-3400 clock. I found that the clock rate is easily improved.■

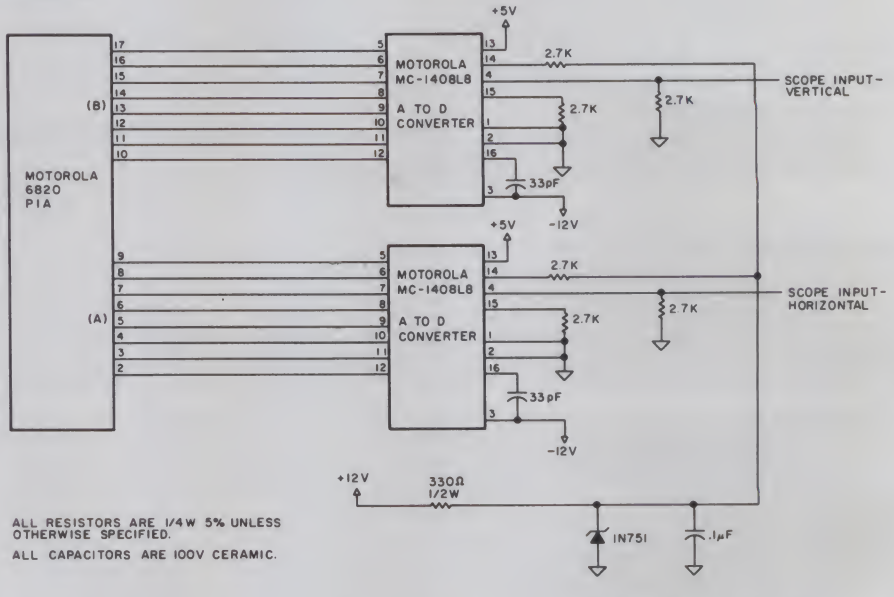
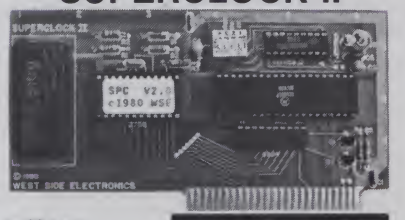


Fig. 1. The circuitry that makes the oscilloscope video display possible. Two Motorola MC 1408s provide the interface between the ET-3400's peripheral interface adapter and a scope. The circuit can be breadboarded in a few minutes and costs under $20.

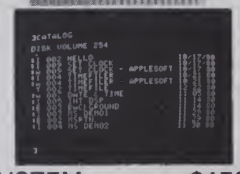
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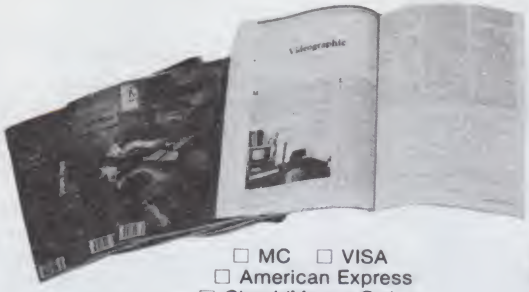
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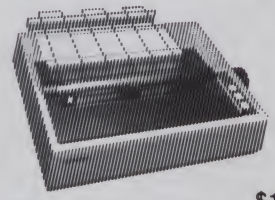
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When you consider the price and performance of this portable microcomputer, and add to it an attractive software package, you end up with a winner.

On the Go With the Osborne 1

By William L. Roberts

The Osborne offers everything I need in a micro—two disks, 64K bytes of memory and a good keyboard. It uses the Z-80A microprocessor and has the CP/M operating system. It has RS-232C, IEEE-480 and modem ports for peripherals and communications. The software includes the WordStar word processing system, MailMerge, MBasic, SuperCalc and CBasic. This is $600 worth of software with a machine that retails for $1795.

The most obvious feature of the Osborne 1 is that it is portable—it looks somewhat like a sewing machine. It's easy to carry, which should make it attractive to the computerist or businessman on the go.

But what sacrifices has Osborne made in the name of portability? Can a machine this small—and at this price—compete in quality with other microcomputers?

I think so. Even without the software, it would be an excellent buy. But with the software, nothing else can top it—not even the new IBM Personal Computer.

The Machine

The small, five-inch screen invites a lot of comments. The first, of course, is, "That sure is a small *screen.*" But it is surprisingly clear. The letters are well formed and the lowercase letters have true descenders. Once you get used to it, it isn't bad at all, at least for data entry.

But you'll have more trouble reviewing text. A 12-inch monitor is optional, and Osborne has announced an 80-column version. I don't think the Osborne will see much use as a word processing system until the 80-column terminal is available.

The Osborne 1 has a 57-key alphanumeric keyboard and a 12-key numeric keypad. Several of the

I have made a patch to my WordStar system to get the four characters left off the keyboard (see Listing 1).

The first step is to assemble the patch, with the CP/M assembler. Note that in the patch the Z-80 instruction CPIR is included as a DB. This is because the CP/M assembler does not recognize Z-80 mnemonics.

Next, load WordStar into memory using DDT. Then the patch is read in. This involves a little bit of disk swapping. The WordStar disk only has 4K of space left on it if you've placed the STAT program there. The patch hex file will require all of that if you put it on the same disk.

The last step is to save the COM file with the CP/M command SAVE. You must save 56 pages.

A list of the commands that must be given are shown below. Only the commands that you type in are listed. I'm assuming that drive A contains a disk with the following features:

- The SYSGEN utility to place CP/M on the disk.
- The WordStar system. This is, in effect, a copy of the WordStar disk as supplied from Osborne.
- The STAT program.
- The patch hex file with the name WSPATCH. HEX.

The disk in drive B should contain DDT.COM. The commands are:

- B:DDT WS.COM (CP/M loads DDT and reads WordStar into it.)
- IWSPATCH.HEX (prepares DDT to bring in the patch.)
- R(DDT will read the patch off of drive A.)
- ^ C(CP/M warm-boot.)
- SAVE 56 WS.COM (Patched version of WordStar is saved.)

To enter the missing characters, press escape, then the character in the table below:

}	]—Right bracket
{	[—Left bracket
~	^ —Caret
`	@—At sign
ESC	ESC

Yes, the escape key must be pressed twice to enter an escape character. If any other character follows an escape key, the escape key will be discarded.■

Listing 1.

```
;       This is a patch for WordStar to allow
;       entry of brackets for Pascal Source
;
;
```

More →

Address correspondence to William L. Roberts, 1433 Coddington Road, Brooktondale, NY 14817.



The front panel of the Osborne 1. Note that all controls are right up front where you can get at them. The two spaces under the disks hold about 20 disks.

ASCII characters are missing from the alpha set—the left and right braces ({ and }), the reverse quote sign (` , hexadecimal 60), the tilda (~, 7E) and the DEL character (7F). These characters supposedly can be typed using control character sequences. The problem is that WordStar does not recognize the sequences. I included the characters by making a patch in WordStar.

I did find an annoying bug in the keyboard. When you press the alpha lock key, you can't type some of the characters: the colon (:), greater-than sign (>), dollar sign ($) and question mark (?). Also, many of the control keys can't be used. This is a problem when creating source text if you want to use only uppercase; it breaks your rhythm, and makes touch-typing difficult.

The dealer told me that not all machines have this problem. A fix is forthcoming for those that do.

Even though there are three standard ports, the port for the monitor is not standard, which seems to violate Adam Osborne's philosophy. He has stated that software should not be supplied only by the manufacturer. Why not the same thing with external peripherals? I may want to hook my Osborne up to my own monitor. But with this connector, I don't know what the pins are for. The first newsletter stated that schematics will be available soon.

The display is a 52 column by 24 line window into a 128 column by 32 line display space. WordStar will begin shifting the screen to the left when the cursor reaches column 44. When you press the control-back arrow, the screen will rotate left. I was skeptical at first, but it looks pretty good. The screen does not scroll one character at a time in jumps, but moves smoothly, one dot at a time. The effect is more disturbing when you're trying to review text than when you're entering text.

The disk drives take soft-sectored, 5¼-inch, single-sided, single-density disks. The disks are formatted with ten 256-byte sectors on 40 tracks. The CP/M BIOS will unpack a single sector to two 128-byte sectors for you, so you can use standard CP/M programs and not worry about this problem.

The disks are for all practical purposes 40 tracks each with 20 sectors of 128 bytes. This gives a total of 102,400 bytes formatted. However, when you run the STAT program for an empty disk, it only reports 90K of disk. This means that disk space is limited if you wish to run some programs, such as PL/1-80 or Pascal MT+. Osborne has announced single-sided, double-density disks as

Listing 1 continued

```
ESC     EQU     1BH     ;ESCAPE CHARACTER
BS      EQU     08H     ;BACK SPACE CHARACTER
CNTL    EQU     0BFH    ;MASK FOR CONTROL KEYS
;
;
PATCH   EQU     032CH   ;PATCH AREA
BIOS    EQU     0EA09H  ;CALL TO BIOS IS HERE
;
;
        ORG     PATCH
        CPI     ESC     ;DID WE GET ESCAPE
        CZ      GOTESC  ;CALL SUBROUTINE IF YES
        CPI     BS      ;IS IT A BACKSPACE
        RNZ             ;RETURN IF NOT
        MVI     A,7FH   ;PUT IN DELETE CHARACTER
        RET             ;AND EXIT
GOTESC  CALL    BIOS    ;GET NEXT CHARACTER
        MOV     A,C
        LXI     H,LIST
        LXI     B,LENLST        ;LENGTH OF LIST
;       CPIR    ;Z-80 INSTRUCTION TO BLOCK
;               ;COMPARE -
;               ;IF Z SET A MATCH WAS FOUND
                ;AND BC GIVES HOW MANY LEFT IN
                ;THE STRING
        DB      0EDH, 0B1H
        RNZ             ;IF NO MATCH, THEN WE ARE
                        ;NOT INTERESTED IN THE
                        ;CHARACTER
                        ;SO SEND IT BACK
        ORI     20H     ;CHANGE TO WHAT IS WANTED
        RET             ;AND BACK IT GOES
;
;
LIST    DB      '@'
        DB      '['
        DB      ']'
        DB      '^'
LENLST  EQU     $-LIST
        END
```



Osborne 1's keyboard is full upper/lowercase. Four of the ASCII characters have been omitted. A 12-key numeric pad is included.

an option. Also, Corvus hard disks should be available soon.

The Z-80A's clock speed is set to 4 MHz. Programs definitely run faster than with the 2 MHz processors I'm used to.

The system comes with 64K bytes of programmable memory included. Of this, 4K is used for screen memory. This leaves 60K for user programs and CP/M.

Software

The major selling point of the Osborne 1 is the software that comes with it. Sure, most machines come with a Basic of some kind. And, when you spring $550 for a disk drive, you get a disk operating system. But the Osborne 1 includes all this plus more.

First, you get the Cadillac of word processors, WordStar. A similar word processor will cost at least $300. Second is MailMerge, and that would cost around $150. SuperCalc, an electronic worksheet program like VisiCalc, is included. Finally you get CBasic, a compiled version of Basic as well as MBasic. This is another $125. So there you have almost $600 worth of software. Even shopping around, I don't think you could do better than $900 for the total software package.

The software has, so far, functioned as advertised. I've used the WordStar the most. I did find one problem. When I'm editing a file, I'll often keep my finger on the control key while I select functions. Occasionally when I hit a wrong key, the system crashes. Otherwise, WordStar is great. In fact, I don't want to go back to the editors we use at work, on a CDC Cyber system—WordStar is better.

Documentation

Three manuals come with the Osborne 1: a user's reference guide, which includes introductory chapters on WordStar and MailMerge, CP/M utility programs, a SuperCalc tutorial, CBasic and an assembly-language programming guide; an MBasic manual, a reference manual on Microsoft's Basic-80; and a WordStar/MailMerge manual by MicroPro. Both the WordStar and MBasic manuals are books, not photocopies of typewritten pages. The WordStar manual is especially excellent.

Graphics

One of the major shortcomings of the Osborne is its limited graphics which consist of 32 special graphics characters generated by the read-only memory (ROM). This is similar to the graphics of the Exidy Sorcerer or the Commodore PET, but the set is not as complete. An inexpensive unit that generates graphics attached to the 488 port would make this a total system.

It is worth noting that, while not documented, the graphics characters (ASCII codes 127 through 159) and the regular character set with each character underscored (ASCII codes 161 through 255) are accessible from Basic as well as machine language.

I've noticed a problem with radio frequency interference. The machine messes up television reception something terrible, and I've learned not to use my computer when the kids are watching "Tom and Jerry."

Service and Support

Osborne Computer Corp. refers almost all service requests through the dealers. This is good if you're close to the dealer, but may be a problem if you're in isolated areas.

Conclusions

So far, I've had no problems that were not my fault. And you must remember that my Osborne was one of the first production models. With most systems, this is a time for nightmares.■



The system set up to run with the optional 12-inch monitor.

Reader Service for facing page ↙55→

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Why Pay More For Word Processing?

By Richard McGrath

Many writers and small-business people would like to have letter-quality word processing, but are put off by the high price of a single-purpose printer. The solution may be interfacing a microcomputer to the office typewriter.

I've assembled this word processing system for just under $3900. Four elements make up the package: an Osborne 1 computer, Escon interface, IBM correcting Selectric III typewriter and MicroPro WordStar software. (See Photo 1.) Without modification this configuration produces copy ready for reproduction.

It would be naive to think that a computer interfaced to a typewriter is a new idea—this was probably the starting place for modern word processing. But a correcting Selectric is not the same thing as a Selectric. The correction key, by controlling the mask-out or lift-off ribbon, makes all the difference. With manual typing, a correcting typewriter may be twice as fast as a noncorrecting one; for inexperienced typists, the correcting machine is up to four times faster. Even when the computer is down or tied up with other work, this "printer" can still produce documents and correspondence.

The May 1981 cover of *Microcomputing* showed a typewriter in a wastebasket. In the same issue ("In Search of the Processed Word," p. 34), Craig Anderton says of word processing systems, "Remember that you can't skimp on anything. Figure on about $3000 for the printer, $1400 for the terminal, $2000 for the disk drive, $2600 for the computer and another $1000 for software, disks, paper and supplies." These figures total $10,000 and presumably exclude software for purposes other than word processing. Many of us don't want to spend $10,000. Where dollars are involved, businessmen ask questions like these:

1. Is the system reliable? Is the service policy adequate? If the equipment breaks down, how long does it take to get it fixed? Am I expected to fix it myself?
2. Can it be expanded? Will the system grow with developing technology? How well do other components and software from different manufacturers fit in? Are the interfaces standardized?
3. How transparent is the word processing software? Is it friendly and easy to use, or difficult? Will I have to retrain my secretary and go to night school to learn about this?
4. What will the system be worth in five years? Is this really a good investment, other than for depreciation value? How much can I expect on a trade-in? Suppose someone develops a whole new approch—will the equipment become obsolete, like a slide rule?

All these questions have something in common. Whether the issue is an



Osborne-Escon-IBM word processing system in operation. Clockwise from large monitor: miscellaneous supplies, ribbons, disks and paper; Osborne 1 computer. Four disks are shown in storage compartment under left disk drive. Documentation and operating manuals are stacked at front, right of computer. Keyboard/cover is supported in desk drawer. Pencil (between monitor and keyboard) points to Escon EP-104 electronics package. IBM correcting Selectric III is shown under lamp. Components have a footprint of 7.1 square feet, excluding cabling, supplies and operating manuals.

Richard McGrath (Studio 7 Technical Documentation, 2640 Melendy Drive, San Carlos, CA 94070) is a technical writing/graphics consultant.

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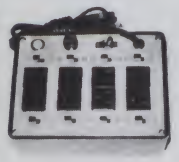
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original equipment purchase, a repair bill, an employee's time or an accounting problem, the bottom line is the amount you write on the check. For $10,000, expect a good word processing system; for $3900 expect a good system, but printout time will be slower—that's the trade-off.

Ground Rules

The system I'm describing assumes these requirements:

1. Production of letter-quality and camera-ready copy is absolutely essential.
2. Each component must have an adequate service/repair policy.
3. Ready-to-operate cost must be under $3900. Resale value of the equipment should be high.
4. Equipment/software must be easy to use and competitive with sophisticated stand-alone word processing systems.
5. The computer will have standardized interfaces, be expandable and accept most hardware, software and peripherals from other manufacturers.
6. The "printer" will include a failsafe feature, so that even if the computer system breaks down you can produce letter-quality and camera-ready copy from the keyboard/printer.

System Components

This word processing system, with brand new components, satisifies the ground rules. The Osborne 1 computer comes with double 5¼-inch disk drives, software, a built-in monitor, RS-232C, modem and battery interfacing. An IEEE-488 signal connector is on the front panel. Software complement includes CP/M, CBasic, MBasic (meets ANSI code BSRX3.60-1978 for Basic-80), Supercalc, WordStar and Mailmerge at no extra cost. As a package, this is a hard deal to beat. Cost breakdown for the complete word processing system is shown in Table 1.

The Osborne 1 is not a toy computer, nor is it a single board or card cage to which extras must be added; it is a Z-80A-based microcomputer system. Keyboard, disk drives, software, monitor and interfacing are included in a package the size of a large briefcase. (A battery pack is an option.) It qualifies as airplane carry-on luggage. The complete unit weighs 24 pounds, and is 100 percent ready to operate. The Osborne will do printerless functions at an experimental field station, in your automobile or in other portable situations. It costs $1795 and includes full documentation.

The second component is an additional Osborne 12-inch monitor. For code and portable use, the built-in 5-inch monitor is adequate. But for word processing, where you must scan and move about through the text frequently, the 12-inch display is a great help. If you need to do serious fixed-station word processing, spend the extra $250 for a large display. The Osborne monitor plugs in and works instantly. A number of sources offer inexpensive plug-in options for standard monitors or TV sets. Osborne dealers can supply more information.

For four years Escon Products has been building interfaces that adapt the IBM Selectric typewriter to microcomputers. They have sold about 4500 of these to industry, individual users and schools. This is one of the few interfaces that is not offensive to IBM; neither the IBM service policy nor its warranty is affected by adding the Escon interface to Selectric I, II or III. That alone is an excellent recommendation. Escon interfaces are now available for other good quality office typewriters, including Olivetti, Remington and IBM models 50, 60 and 75.

The printing module I've chosen is

Item	Price
Osborne 1 computer	$1795.00
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Interface installation	125.00
IBM correcting Selectric III	1035.00
Subtotal	$3805.00
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Total price (includes software)	$3897.50

Table 1. Cost breakdown for $3900 word processing system.

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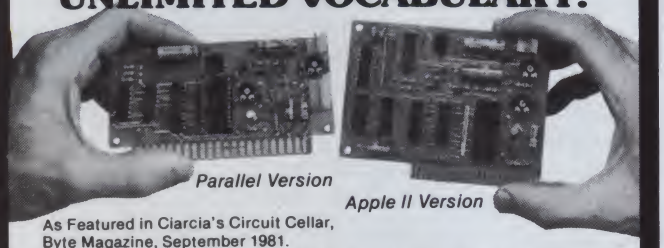
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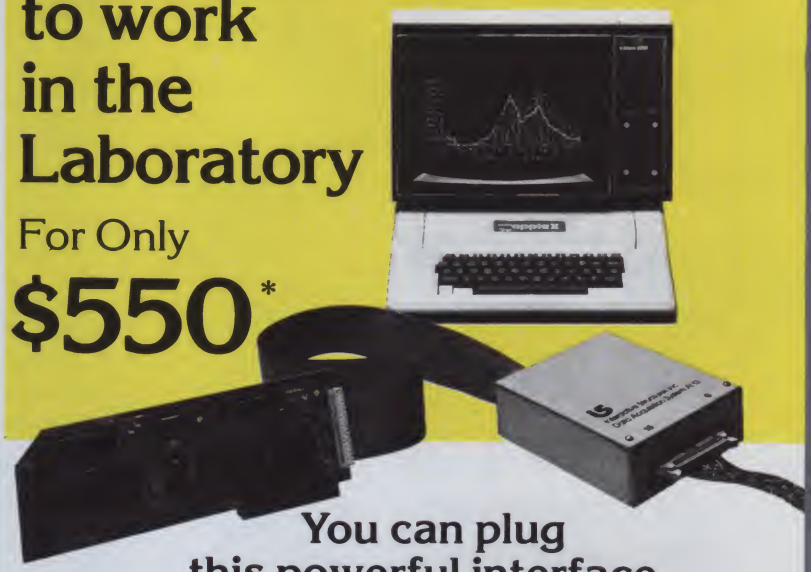
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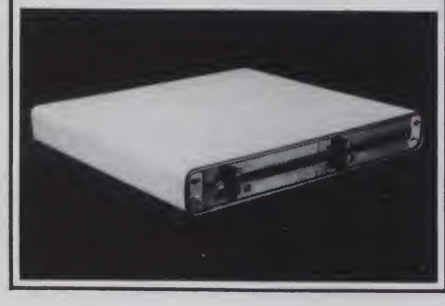
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an IBM correcting Selectric III. Regardless of how fast a printer executes commands and produces copy, any serious malfunction upstream from the printer results in typewriter-only status. Unless the typewriter/printer has a self-correcting feature, the operator must revert to drippy bottles of whiteout, krinkled little pieces of mask-out paper that always seem to get lost, or to sticky-back.

Another reason for choosing Selectric is that the resale value of an IBM typewriter is high; a used Selectric I sells for $700 to $900 depending on condition. Used correcting Selectric IIs are hard to find and secondhand Selectric III's are rarely available at all. The final reason is the interchangeable printball—type fonts can be changed easily. This is also true of daisywheel printers, but the cost is much higher.

When you buy a Selectric, you get to choose two printballs. I suggest that one of these be Letter Gothic if you plan on a lot of technical writing. The second printball can be anything you like. OCR-A provides standard ANSI characters and is compatible with most optical character recognition equipment.

MicroPro WordStar is the controlling software. All the common format and printing parameters can be adjusted. Many less common ones can also be addressed. Few commands are required to make the system work; learning the subtleties takes time. A page format example is included at the end of this article to start you off.

Theory of Operation

When one key on the IBM Selectric is pressed, an actuator selects a combination of linkage bails, which act as mechanical latch encoders. Position and tilt of the printball are determined by the coded information. After a character is transferred to paper, the ball carriage moves ahead one space and the process is repeated.

Under computer control, you don't need to press typewriter keys. Input from the Osborne keyboard is processed by software and stored in memory. (The Osborne has 64K bytes of random-access memory (RAM) and floppy disks with 100K bytes each of storage. One soft-sectored disk holds about 30 pages of single-spaced text, although you should leave space on disk for editing changes.) On the print command, serial data is transferred to the Escon electronics package, then to an electromechanical interface at the typewriter. Solenoids select linkage bails that position the print ball. Additional solenoids provide space, line feed/return, print and shift.

Solenoids mount inside the Selectric case. Existing screw holes in the die-cast typewriter frame are used for mounting. There is no change in outward appearance or operating touch at the keyboard. Ribbon cable links the electromechanical unit and electronics package.

The Escon EP-104 electronics package measures 5 × 3 × 10 inches. It consists of a single printed circuit board housed in a dual-U aluminum enclosure along with fuse, transformer, 110 V power connector, voltage regulator and three-way toggle switch. An on-board microprocessor controls the EP-104. The 6802 microprocessor provides clock, logic control and 128 bytes of internal RAM. A 2708 erasable programmable read-only memory (EPROM) chip is used for program storage. Integrated circuit 6522 supplies system communication, with lines to solenoid drivers, input switches and the RS-232 universal asynchronous receiver transmitter (UART) clock.

In operation, a received character from the computer serial port initiates an interrupt routine. (Escon makes both serial and parallel interfaces, but they recommend serial interfacing for the Osborne-Escon-IBM package.) Data is read and placed in a 96-character buffer. The main program loop reads data from this buffer and either prints a character or performs the appropriate command function.

Hardware Setup

It's not hard to get the pieces together and working. After your equipment arrives, follow these instructions:

1. Unpack and inventory all the parts, connecting cables, bits and pieces.

2. Read the instruction manuals for the Osborne, Escon and IBM hardware. Study the WordStar section in the Osborne user's guide.

3. Plug in the Selectric and make certain the machine works to your satisfaction as a stand-alone unit.

4. Connect EP-104 to the Selectric. Two connections are required: ribbon cable from the electromechani-

cal interface plugs into one end of EP-104 and a special power cord from the typewriter plugs in nearby.

5. Turn the Selectric on. Insert a sheet of paper sideways to ensure a long typing space. Toggle the switch on EP-104 to down position. A line of typewritten characters will be produced. This is a built-in self test.

6. Return switch to up, then back to middle, to stop self test.

7. Set up the Osborne. Make sure the built-in monitor works. Turn power off. Remove shorting plug on front panel, then plug in the 12-inch monitor. Turn power on. Display will appear on large monitor.

8. The system is ready to operate when an RS-232 cable is connected between electronics package and computer.

Before making the final connection, format your blank disks, make copies of original software and set up the correct data rate (1200). Follow instructions in chapters one and two of the Osborne user's guide. These preliminary steps are not only good operating practice, but give you initial hands-on experience with the computer. Remove disks from both drives and turn computer off.

> Not many things can go wrong, provided everything worked when it arrived.

Using WordStar

Turn the computer on. It will beep and display the following:

```
Osborne System ONE.
MONITOR 1.2
Insert disk in Drive A and press RETURN.
```

Insert the WordStar/Mailmerge disk in drive A (left) and latch in place. Put a formatted disk in drive B (right) and latch in place. Press return. The Osborne logo will appear, followed by:

```
Loading WORDSTAR. . .
```

Wait a few moments. Copyright information, and then a menu, will appear. For the time being, ignore everything on the display and press D (wait). When prompted, type B:XXX (return)(wait). A menu will appear that occupies the top quarter of the display. The first line will read:

```
B:XXX PAGE 1 LINE 1 COL 01
```

That's all there is to starting WordStar—it's ready to work when you are. Type a couple of sentences from the computer keyboard. Letters will appear on the display as you type. Type for a while and the display window will move across space that didn't appear before. Don't be alarmed; this is normal. The Osborne displays a window of 24 lines of 52 characters. The monitor has lines of 128 characters, and characters in the line are revealed as the window moves.

Saving Text. After you've entered your copy, hold down the control key (marked CTRL) and press K. Wait a few moments and press D. A prompt will tell you that file B:XXX is being saved. When the menu reappears, press D. When prompted, type B:XXX (return) and your saved material should reappear on the display. This, at least, lets you know that the



See List of Advertisers on page 178

software is working. Save text at least once per page, as you enter copy, to prevent loss.

Printing. To make the final connection between computer and printer, press Reset; take both disks out of the drives; connect one end of the serial (RS-232) connector cable to EP-104 and the other connector end to the RS-232C plug on the Osborne front panel. Install WordStar/Mailmerge in drive A and your working disk in drive B. Press return (wait); press P (wait). The prompt will ask what file to print, respond by typing B:XXX (return) (wait). A series of prompts will ask a number of print-related questions; ignore them and press return six times, when the following prompt will appear:

Ready the printer and type RETURN

Turn the Selectric on and insert paper lengthwise. Set the left margin at 24 and spacing to single line. Press return. If everything went together perfectly the first time, the typewriter would print out the contents of file B:XXX. This is an unusual expectation—more often than not, something goes awry.

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Troubleshooting

Not many things can go wrong, provided everything worked when it arrived. This is to help you through the most common interconnection errors among the basic system components:

●*Symptom: No Printout.*

1. Be sure the typewriter is turned on.

2. Check that all power cords, ribbon cable and RS-232 connectors are securely socketed.

3. On the back of the Escon electronics package, locate self-test toggle switch. The normal operating position is middle. Press switch down with typewriter on. Selectric should output a line of characters. Toggle switch to up position. Printout should cease. Return switch to middle.

4. Press reset. Press return. Call up file B:XXX. Use control-K (wait) P command. Respond to the prompts. Selectric should output file B:XXX.

●*Symptom: Nonsense Printout.*

1. Turn typewriter off. Press reset. Remove both disks from drives. Install CP/M in drive A. Press return. Press escape (ESC). When prompted, type setup (return) (wait). Data rate should be 1200 and printer "standard serial." If not, follow prompts and user's guide to correct.

2. Exit CP/M. Install WordStar/Mailmerge in drive A, and working disk in drive B. Press return and try again.

●*Symptom: Printout OK but in Strange Location.*

1. Refer to WordStar section of user's guide under "Margins" and "Dot Commands." Make insertions as directed.

2. Press control-K (wait) P, and try again.

●*Symptom: Partial Printout.*

1. Turn Selectric off. Press reset. Remove disks from both drives. Turn Osborne off. Reverse RS-232 connector cable end for end. Turn Osborne on.

2. Install WordStar/Mailmerge in drive A and working disk in drive B. Press return and try again.

●*Symptom: Nothing Helps, It Won't Work.*

1. Call Escon. Describe the problem and ask for help.

2. Call your Osborne dealer. Describe the problem and ask for help. The corporate headquarters in Hayward, CA, has an Osborne-Escon-IBM word processing system in everyday use and has verified that the combination performs correctly.

Page Format Example

The following settings for WordStar software and IBM Selectrics will produce 8½ × 11-inch pages of text with 1¼-inch margins and 1½ line spacing. Text starts 1-1/8 inches from page top. Printing stops 1-1/8 inches from page bottom for new paper insertion. Heading appears 3/8 inch from paper top with 5/8 inch between heading and start of text. Page numbers are not printed but can be inserted after final editing. No heading is printed on the first page. Refer to WordStar section of user's guide for more details.

Selectric Settings. Linespace = 1½; L Margin = 24; R Margin = Extreme R position. Align paper one space above first red line on guide. Pitch = 12. Adjust paper guide L or R to center text on page.

Software Settings. Right Margin (CTRL 0 (wait) R) = 72. Page 1, Line 1: Paper Length (.PL) = 40; Top Margin (.MT) = 3; Bottom Margin (.MB) = 0; start text on Line 1. Stop text after Line 35. Text stop (CTRL C) = Line 36. Page End (.PA) = Line 37. Page 2, Line 1: Text Heading (.HE) = Insert heading on this page only. All pages: start text on Line 1; stop text after Line 35; Text Stop (CRTL C) = Line 36; Page End (.PA) = Line 37. Other settings = DEFAULT.

Changes in format can easily be made after you've had some experience with the system. This format satisfies most text requirements for double spacing and wide margins in submitted manuscripts. It is also acceptable for the usual college or university writing requirements. With 12-pitch Letter Gothic printball, each page has 35 lines of typing, exclusive of heading and footing. Each line consists of 72 characters/spaces. Printing time is three to four minutes per page depending on paragraph length and layout.■

Equipment Manufacturers

Escon Products, Inc., 12919 Alcosta Blvd., San Ramon, CA 94583. Phone 415-820-1256.

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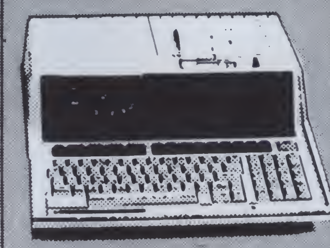
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Here's a good example of computer problem-solving using structured programming techniques.

Pascal Meets Instant Insanity

By Michael K. Kan

Instant Insanity is a game involving the arrangement of four color cubes. Assume that the six surfaces of a cube are labeled top, bottom, north, east, south and west, and that the given colors of the four cubes are represented as in Fig. 1. The problem is to find a systematic way to arrange the cubes with no color duplication in any of the four directions (north, east, south and west).

Manual Approach

The Instant Insanity game can be solved manually (with a great deal of patience) by the following steps:

1. Start with cube 1 in the given position.
2. Put cube 2 on top of cube 1.
3. Check for any duplication of color between cube 1 and cube 2 in the four directions (north, east, south, west).
4. If there is duplication of color in step 3, move cube 2 to a new position and repeat step 3.
5. If there is no duplication of color in step 3, put cube 3 on top of cube 2.
6. Check for any duplication of color between cube 1, cube 2 and cube 3 along the four directions.
7. If there is any duplication of color in step 6, move cube 3 to a new position and repeat step 6.
8. If there is no duplication of color in step 6, put cube 4 on top of cube 3.
9. Check for any duplication of color between cube 1, cube 2, cube 3, and cube 4 along the four directions.
10. If there is duplication of color in step 9, move cube 4 to a new position and repeat step 9.
11. If there is no duplication of color in step 9, you have solved the Instant Insanity problem.
12. If you haven't found a solution after cube 1 has been moved through all 24 possible positions, you can conclude that there is no solution to the Instant Insanity problem for the given set of color cubes.

Assume that a new position is available in the above steps. Since there are six surfaces on a cube and a cube can rotate four times while lying on each surface, there are 24 nonduplicating positions for each cube. In step 4, if all 24 positions of cube 2 have been tested earlier, move cube 1 to

Direction \ Cube number	1	2	3	4
Top	yellow	yellow	yellow	yellow
Bottom	white	green	white	white
North	red	white	green	yellow
East	red	white	green	red
South	green	green	green	green
West	white	red	red	red

Fig. 1. Colors of the four cubes for the Instant Insanity problem.

Direction \ Cube number	1	2	3	4
Top	yellow	white	green	red
Bottom	white	green	green	red
North	red	white	yellow	green
East	red	yellow	green	white
South	green	red	white	yellow
West	white	green	red	yellow

Fig. 2.

Address correspondence to Michael K. Kan, Scripps Memorial Hospital, 9888 Genessee Ave., La Jolla, CA 92037.

the next position and go back to step 1 instead of repeating step 3.

Similarly, in step 7, if all 24 nonduplicating positions of cube 3 have been tested, move cube 2 to a new position and go to step 3 instead of repeating step 6. In step 10, if all 24 positions of cube 4 have been tried move cube 3 to a new position and go to step 6 instead of repeating step 9.

Since you don't know which combination of cube positions will finally solve the Instant Insanity problem, you don't know the number of necessary moves. It depends on the initial cube position and the particular set of color cubes provided. In the worst situation, the maximum number of moves is 331,776 (all possible combinations of cube positions). This is laborious and time-consuming to do manually, and it is hard to avoid duplicating moves.

Computer Method

A computer, following the steps just outlined, can find a simple solution to Instant Insanity. It can test for color matches and keep track of cube moves much better than we can.

I've subdivided the program into several procedures—initialize, move (cube), evaluate (for color match) and printcolor (of all cubes). The move procedure is a cube-turning generator to create the 24 nonduplicating positions of a given cube. The evaluate procedure will simulate the visual inspection of the cube stack for any color matches along its four directions (north, east, south and west). It will return a Boolean result (colormatch), whose value is true if there is any color duplication along any of the four directions; otherwise the value false is returned.

The Colorcubes program in Listing 1 was written in UCSD Pascal running on a Cromemco Z2 computer with 64K bytes of memory. It will also run on the Apple Pascal system or comparable Pascal compiler.

The data representation of Colorcubes in Pascal is straightforward. For example, the colors on the surfaces of the four cubes can be represented by a two-dimensional array, Color. This is declared in Pascal as Var Color: array [cubenumber,direction] of colortype. Cubenumber, direction, and colortype are declared earlier as:

```
Type
cubenumber = 1..4;
direction = (top,bottom,north,east,south,west);
colortype = (yellow,green,white,red).
```

Move is an important procedure in the program. It lets you make three movements—Rotate, Flipsouth (flip along the south border) and Flipeast (flip along the east border). From the initial given position, the 24 nonduplicating cube positions can be obtained as below:

```
STARTING CONDITIONS:

THE 4 CUBES ARE ARRANGED WITH THE COLORS SHOWN BELOW:
CUBE    TOP       BOTTOM    NORTH     EAST      SOUTH     WEST
  1     YELLOW    WHITE     RED       RED       GREEN     WHITE
  2     YELLOW    GREEN     WHITE     WHITE     GREEN     RED
  3     YELLOW    WHITE     GREEN     GREEN     GREEN     RED
  4     YELLOW    WHITE     YELLOW    RED       GREEN     RED

TOTAL NUMBER OF CUBE MOVES = 108

A SOLUTION IS FOUND AS BELOW:
THE 4 CUBES ARE ARRANGED WITH THE COLORS SHOWN BELOW:
CUBE    TOP       BOTTOM    NORTH     EAST      SOUTH     WEST
  1     YELLOW    WHITE     RED       RED       GREEN     WHITE
  2     WHITE     GREEN     WHITE     YELLOW    RED       GREEN
  3     GREEN     GREEN     YELLOW    GREEN     WHITE     RED
  4     RED       RED       GREEN     WHITE     YELLOW    YELLOW
```

Fig.3. Console display.

Listing 1.

```
PROGRAM COLORCUBES (INPUT,OUTPUT);

CONST
  MAXCUBE = 4;  MAXMOVES = 24;
  CUBE1 = 1;    CUBE2 = 2;     CUBE3 = 3;       CUBE4 =  4;

TYPE
  CUBENUMBER = 1..MAXCUBE;
  COLORTYPE = (YELLOW,GREEN,WHITE,RED);
  DIRECTION = (TOP,BOTTOM,NORTH,EAST,SOUTH,WEST);
  COLOROFCUBE = ARRAY [CUBENUMBER,DIRECTION] OF COLORTYPE;
  CUBEMOVES = ARRAY [CUBENUMBER] OF 0..MAXMOVES;

VAR
  TOTALMOVES:INTEGER;
  CUBEINDEX:CUBENUMBER; SIDEINDEX:DIRECTION;
  COLOR : COLOROFCUBES;
  MOVES : CUBEMOVES;
  FINDANS,MATCH2,MATCH3,MATCH4:BOOLEAN;

  PROCEDURE INITIALIZE;
    VAR CUBEINDEX:CUBENUMBER;
  BEGIN
    (*SET UP COLOR OF ALL SIDES OF CUBE 1 - 4*)
    COLOR[CUBE1,TOP]:=YELLOW;     COLOR[CUBE1,BOTTOM]:=WHITE;
    COLOR[CUBE1,NORTH]:=RED;      COLOR[CUBE1,EAST]:=RED;
    COLOR[CUBE1,SOUTH]:=GREEN;    COLOR[CUBE1,WEST]:=WHITE;
    COLOR[CUBE2,TOP]:=YELLOW;     COLOR[CUBE2,BOTTOM]:=GREEN;
    COLOR[CUBE2,NORTH]:=WHITE;    COLOR[CUBE2,EAST]:=WHITE;
    COLOR[CUBE2,SOUTH]:=GREEN;    COLOR[CUBE2,WEST]:=RED;
    COLOR[CUBE3,TOP]:=YELLOW;     COLOR[CUBE3,BOTTOM]:=WHITE;
    COLOR[CUBE3,NORTH]:=GREEN;    COLOR[CUBE3,EAST]:=GREEN;
    COLOR[CUBE3,SOUTH]:=GREEN;    COLOR[CUBE3,WEST]:=RED;
    COLOR[CUBE4,TOP]:=YELLOW;     COLOR[CUBE4,BOTTOM]:=WHITE;
    COLOR[CUBE4,NORTH]:=YELLOW;   COLOR[CUBE4,EAST]:=RED;
    COLOR[CUBE4,SOUTH]:=GREEN;    COLOR[CUBE4,WEST]:=RED;
  (*INITIALIZE FINDANS - BOOLEAN VALUE TO REPRESENT ANSWER IF FOUND*)
    FINDANS:=FALSE;
  (*RESET THE NO. OF MOVES IN EACH CUBE TO BE ZERO*)
    FOR CUBEINDEX:=1 TO MAXCUBE DO
      MOVES[CUBEINDEX]:=0;
  END(*INITIALIZE*);

PROCEDURE PRINTCOLOR; (*PRINT COLORS ON ALL SIDES OF EACH CUBE*)
VAR
  CUBEINDEX:CUBENUMBER; SIDEINDEX:DIRECTION;
  CURRENTCUBE:0..4;
BEGIN
  WRITELN;
  WRITELN('  THE 4 CUBES ARE ARRANGED WITH THE COLORS SHOWN BELOW:');
  WRITELN;
  WRITELN('  CUBE    TOP       BOTTOM    NORTH     EAST      SOUTH     WEST');
  CURRENTCUBE:=0;
  FOR CUBEINDEX:=1 TO MAXCUBE DO
    BEGIN
      CURRENTCUBE:=CURRENTCUBE+1;
       WRITELN;
       WRITE('   ',CURRENTCUBE:4,'     ');
   FOR SIDEINDEX:=TOP TO WEST DO
     BEGIN
       CASE COLOR[CUBEINDEX,SIDEINDEX] OF
       YELLOW: WRITE('YELLOW     ');
       GREEN:  WRITE('GREEN      ');
       WHITE:  WRITE('WHITE      ');
       RED:    WRITE('RED        ');
       END (*CASE*);
```

More

Listing continued.

```
      END(*FOR SIDEINDEX*);
    END(*FOR CUBEINDEX*);
  WRITELN;
END(*PRINTCOLOR*);

PROCEDURE MOVE(CUBE:CUBENUMBER);
(*PROCEDURE TO MOVE CUBE TO POSITION 1 THROUGH POSITION 24 IN A GIVEN*)
(*SEQUENCE.  THE CUBEPOSITION IS KEPT IN A CUBEPOSITION ARRAY*)

  PROCEDURE ROTATE(CUBE:CUBENUMBER); (*ROTATE CUBE IN ANTICLOCKWISE DIREC-
    TION*)
  VAR OLDNORTH,OLDEAST,OLDSOUTH,OLDWEST:COLORTYPE;
  BEGIN
    OLDNORTH:=COLOR[CUBE,NORTH];
    OLDEAST:=COLOR[CUBE,EAST];
    OLDSOUTH:=COLOR[CUBE,SOUTH];
    OLDWEST:=COLOR[CUBE,WEST];
    COLOR[CUBE,NORTH]:=OLDWEST;
    COLOR[CUBE,EAST]:=OLDNORTH;
    COLOR[CUBE,SOUTH]:=OLDEAST;
    COLOR[CUBE,WEST]:=OLDSOUTH;
  END(*ROTATE*);

  PROCEDURE FLIPEAST (CUBE:CUBENUMBER);(*FLIP CUBE ALONG EAST BORDER*)
    VAR OLDTOP,OLDEAST,OLDWEST,OLDBOTTOM:COLORTYPE;
  BEGIN
    OLDTOP:=COLOR[CUBE,TOP];
    OLDEAST:=COLOR[CUBE,EAST];
    OLDWEST:=COLOR[CUBE,WEST];
    OLDBOTTOM:=COLOR[CUBE,BOTTOM];
    COLOR[CUBE,TOP]:=OLDWEST;
    COLOR[CUBE,EAST]:=OLDTOP;
    COLOR[CUBE,WEST]:=OLDBOTTOM;
    COLOR[CUBE,BOTTOM]:=OLDEAST;
  END(*FLIPEAST*);

  PROCEDURE FLIPSOUTH(CUBE:CUBENUMBER); (*FLIP CUBE ALONG SOUTH BORDER*)
    VAR OLDTOP,OLDNORTH,OLDSOUTH,OLDBOTTOM:COLORTYPE;
  BEGIN
    OLDTOP:=COLOR[CUBE,TOP];
    OLDNORTH:=COLOR[CUBE,NORTH];
    OLDSOUTH:=COLOR[CUBE,SOUTH];
    OLDBOTTOM:=COLOR[CUBE,BOTTOM];
    COLOR[CUBE,TOP]:=OLDNORTH;
    COLOR[CUBE,SOUTH]:=OLDTOP;
    COLOR[CUBE,NORTH]:=OLDBOTTOM;
    COLOR[CUBE,BOTTOM]:=OLDSOUTH;
  END(*FLIPSOUTH*);

  BEGIN (*MOVE*)
    TOTALMOVES:=TOTALMOVES+1;
  MOVES[CUBE]:=MOVES[CUBE]+1;
    CASE MOVES[CUBE] OF
  1,2,3: ROTATE(CUBE);
  4    : BEGIN  ROTATE(CUBE); FLIPSOUTH(CUBE) END;
  5,6,7: ROTATE(CUBE);
  8    : BEGIN ROTATE(CUBE); FLIPEAST(CUBE) END;
  9,10,11: ROTATE(CUBE);
  12     : BEGIN ROTATE(CUBE); FLIPSOUTH(CUBE) END;
  13,14,15: ROTATE(CUBE);
  16     : BEGIN ROTATE(CUBE); FLIPSOUTH(CUBE) END;
  17,18,19: ROTATE(CUBE);
  20     : BEGIN ROTATE (CUBE); FLIPEAST(CUBE) END;
  21,22,23: ROTATE(CUBE);
  24     : BEGIN ROTATE(CUBE); FLIPSOUTH(CUBE) END;
    END(*CASE CUBEPOSITION*);
  END(*MOVE*);

  PROCEDURE EVALUATE(CUBE:CUBENUMBER; VAR COLORMATCH:BOOLEAN);
  (*PROCEDURE THAT EVALUATES THE COLORS ON THE NORTH,EAST,SOUTH&WEST*)
  (*SIDES OF CUBE1 & CUBE2, OR CUBE1, CUBE2 & CUBE3 OR CUBE1 THRU CUBE4*)
  (*IF THERE IS ANY COLOR MATCH AT ALL ON EITHER DIRECTION, THE BOOLEAN*)
  (*VARIABLE COLORMATCH IS RETURNED AS TRUE, ELSE FALSE IS RETURNED    *)
  TYPE
    COLORSET = SET OF COLORTYPE;
  VAR
    SIDECOLOR:ARRAY [DIRECTION] OF COLORSET;
    CUBEINDEX:CUBENUMBER;
    SIDEINDEX:DIRECTION;
  BEGIN(*EVALUATE*)
    (*FIRST ADD COLORS OF THE 4 SIDES OF CUBE1 TO THE SET OF COLOR BELONGING*)
    (*TO THE NORTH,EAST,SOUTH & WEST DIRECTIONS*)
    SIDECOLOR[NORTH]:=[COLOR[CUBE1,NORTH]];
    SIDECOLOR[EAST]:=[COLOR[CUBE1,EAST]];
    SIDECOLOR[SOUTH]:=[COLOR[CUBE1,SOUTH]];
    SIDECOLOR[WEST]:=[COLOR[CUBE1,WEST]];
    COLORMATCH:=FALSE;
    SIDEINDEX:=BOTTOM; (*INITIALIZE SIDEINDEX AT BOTTOM SO THAT SUCC(BOTTOM)*)
                       (*OR NORTH SIDE WILL BE EVALUATED FIRST*)
    WHILE (SIDEINDEX<WEST) AND (NOT COLORMATCH) DO
      BEGIN '*CHECK FOR COLOR MATCH ON ALL 4 DIRECTIONS*)
        SIDEINDEX:=SUCC(SIDEINDEX);
        CUBEINDEX:=1;
        WHILE (CUBEINDEX<CUBE) AND (NOT COLORMATCH) DO
          BEGIN (*ON ANY DIRECTION, CHECK FOR COLOR MATCH*)
          CUBEINDEX:=CUBEINDEX+1;
            IF COLOR [CUBEINDEX,SIDEINDEX] IN SIDECOLOR [SIDEINDEX]
              THEN COLORMATCH:=TRUE
                ELSE
    SIDECOLOR[SIDEINDEX]:=SIDECOLOR[SIDEINDEX]+[COLOR[CUBEINDEX,SIDEINDEX]];
          END(*WHILE CUBEINDEX*);
      END(*WHILE SIDEINDEX*);
      END(*EVALUATE*);

    (*MAIN PROGRAM*)
    BEGIN
      INITIALIZE;
      WRITELN('STARTING CONDITIONS:');
      WRITELN;
      PRINTCOLOR;
      (*SET NO. OF CUBE MOVES TO ZERO*)
```

More →

```
Position 1,2,3: rotate
Position 4    : rotate, then flipsouth
Position 5,6,7: rotate
Position 8    : rotate, flipeast
Position 9,10,11: rotate
Position 12     : rotate, flipsouth
Position 13,14,15: rotate
Position 16     : rotate,flipsouth
Position 17,18,19: rotate
Position 20     : rotate,flipeast
Position 21,22,23: rotate
Position 24     : rotate, flipsouth.
```

The above sequence can be verified manually by means of a cube. As given in the Pascal listing, the Rotate, Flipsouth and Flipeast moves are done by exchanging the colors on different sides of the cube. For example, you rotate (counterclockwise) by shifting the old color of the cube from the east to the south side, the color from the south to the west side, the color from the west side to the north side and the color from the north side to the east side, while the colors at the top and bottom remain unchanged.

After each move, the position is checked by the Evaluate procedure for color duplication and for a solution. The evaluator uses the Set feature of Pascal to check for duplication of color in a given direction. Each direction of the cube stack is represented by a set of colors. Each cube on the cube stack is examined to see if its color is already in the color set. If it is not, the color is added to the set. If it is already in the set, the color is duplicated and the evaluate procedure ends with the value of Colormatch set to true. This indicates a color duplication and that the current positions are not a solution.

Solution

A solution is found after 108 moves. The final cube positions are shown in Fig. 2. The console output for the program is given if Fig. 3.

Discussion

Instant Insanity is a good example of computer problem-solving. By breaking the problem into subproblems, the original problem becomes simpler. Similarly, a subproblem can be further subdivided into smaller problems (e.g., the rotate, flipeast and flipsouth routines).

Pascal is a structured language that supports this sort of top-down programming. Data representation of the color cubes is simplified by the

user-defined types (e.g., colortype and direction) of Pascal. Checking for color duplication in a given direction is easy with the Set feature in Pascal.■

(Editor's Note: In working with this program a few embellishments came to mind. Unfortunately, we didn't have time to develop them. Please feel free to help us with these.

The program would be a good deal more interesting for the user if the Initialize procedure were rewritten to be interactive. Then different sets of cube colors could be entered from the keyboard while the program was running. As it is now, it is necessary to edit and recompile the procedure to enter a different problem than the one offered by Mr. Kan.

An even more ambitious project would be to use the color and turtle graphics features of Pascal to provide color displays of the original problem and its final solution.

How might the program be enhanced to find all possible solutions for a given set of cube colors?

All of these features are readily possible with Pascal.—HN)

Listing continued.

```
TOTALMOVES:=0;
(*EXAMINE ALL COMBINATIONS  OF CUBE POSITIONS. STOP WHEN SOLUTION IS FOUND*)
  REPEAT
    MOVES[CUBE2]:=0; (*RESET NO. OF MOVES IN CUBE2*)
    WHILE (NOT FINDANS) AND (MOVES[CUBE2] < 24) DO
    BEGIN
        EVALUATE(CUBE2,MATCH2);
        IF (NOT MATCH2) THEN
        BEGIN MOVES[CUBE3]:=0; (*RESET NO. OF MOVES FOR CUBE3*)
        WHILE (NOT FINDANS) AND (MOVES[CUBE3] < 24) DO
        BEGIN
          EVALUATE (CUBE3,MATCH3);
          IF (NOT MATCH3) THEN
          BEGIN MOVES[CUBE4]:=0; (*RESET NO. OF MOVES FOR CUBE4*)
            WHILE (NOT FINDANS) AND (MOVES[CUBE4] < 24) DO
            BEGIN
              EVALUATE (CUBE4,MATCH4);
                IF (NOT MATCH4) THEN FINDANS:=TRUE
                    ELSE
                      MOVE(CUBE4);
            END(*WHILE*);
          END(*IF(NOTMATCH3) *);
          IF (NOT FINDANS) THEN
              MOVE(CUBE3);
        END(*WHILE*);
        END(*IF (NOT MATCH2) *);
        IF (NOT FINDANS) THEN
            MOVE(CUBE2);
      END(*WHILE*);
      (*IF ANSWER IS NOT FOUND, PROCEED TO NEXT POSITION OF CUBE1*)
      IF (NOT FINDANS) THEN MOVE(CUBE1);
  UNTIL FINDANS OR (MOVES[CUBE1]>=24);
  WRITELN;
  WRITELN('TOTAL NUMBER OF CUBEMOVES = ',TOTALMOVES);
  IF FINDANS THEN
    BEGIN
      WRITELN;
      WRITELN(' A SOLUTION IS FOUND AS BELOW:');
      PRINTCOLOR;
    END
  ELSE
    BEGIN
      WRITELN;
        WRITELN(' NO SOLUTION IS FOUND');
        WRITELN(' THE FINAL CONFIGURATION OF THE CUBES IS:');
        PRINTCOLOR;
    END;
    END(*MAIN PROGRAM*).
```


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By Ken Barbier

Five years I waited, fussing and fuming, before I purchased a typewriter-quality printer that my home-built computer could talk to.

I do a lot of writing at home, both in the line of business and for my own satisfaction. My typing error rate is about 20 percent, and I knew my home computer could do better. But I just couldn't justify three kilobucks for a home-use-only machine. Besides, you can buy a good electric typewriter for $300. Why should one that your computer can talk to cost *ten* times as much?

I was tempted by the reconditioned IBM Selectrics, or the add-on interfaces for them. But their purchasers fell into two categories: ecstatically happy or mad as hell. I was afraid to try a used product that had a 50 percent success rate and still cost almost $2000.

I was even tempted once to try a box full of solenoids that fit over the keyboard of "any standard typewriter." But I couldn't get the manufacturer to state categorically that the box would work on my Smith-Corona 200 electric. Well, that manufacturer is no longer in business anyway.

From the above you can see that I did not require blazing speed. My final draft output rate is four clean pages of double-spaced typing per hour, or 18 baud in terms a computer can understand. That's right. Two characters per second, net, for clean copy. My talents lie elsewhere.

Considering the above production rate, you probably can't comprehend my sales resistance. Well, it galled me that anyone could charge so much for a computer-compatible machine when every electric typewriter already had 90 percent of the required machinery. Why couldn't someone just add a simple interface?

> There it was, cranking out the very form letters that announced its existence.

Anticipation

Suddenly, according to all the advertisements and press releases, simply *everyone* was coming out with computer-compatible versions of electric typewriters that were priced, brand new and with a warranty, at about $1200. I sent for specs on every one I heard of. Never saw any actual machines, however. Well, they would be here any day now, I was told.

And suddenly there it was—the Olympia ES-100 RO typewriter/printer. Sitting right there on the bench, plugged into the ubiquitous Apple, actually cranking out the very form letters that announced its existence. No, I couldn't have it. It was the dealer's first one. But next month. . . .

Consummation

And there it was—my very own Oly. (On the west coast, "Olympia" is pronounced "Oly." Something to do with water.) I couldn't wait to hustle it into my car and get it home to play with.

I tried to give the dealer a check for more than the Oly cost, but it turned out that the spare ribbons and typewheels I wanted wouldn't be arriving for another month or so. But, I was assured by the salesman, the carbon ribbon in the machine would last a long time. He didn't know my backlog.

Application

The ES-100 RO consists of a wide-carriage daisywheel typewriter that is a standard Olympia office product, with an add-on interface board produced by Dataface, Inc., of Santa Clara, CA. The nearest Olympia representative had assured me that the add-on interface was approved by Olympia International, and did not void the typewriter warranty or affect available service. While this is true in principle, it didn't work out in practice, as we will be seeing later.

The documentation supplied by both Olympia and Dataface is minimal but adequate. Since my machine was sold with the interface installed, I didn't have to drill the holes in the back panel of the typewriter that are required to mount the RS-232 serial interface connector. You can buy the interface by itself, and add it to your own Olympia, if you already

Address correspondence to Ken Barbier, PO Box 1253, Borrego Springs, CA 92004.

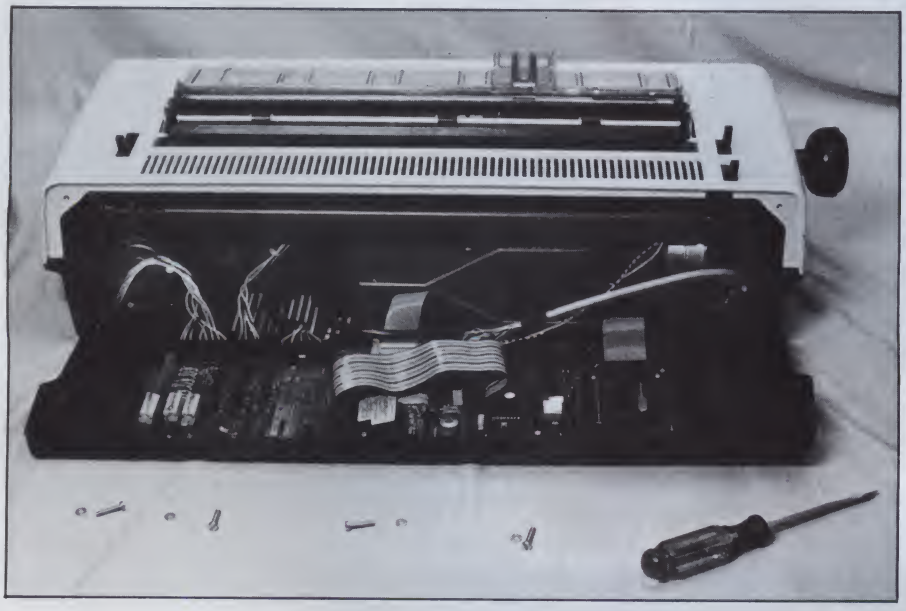
own the typewriter.

The interface provides for selection of one of four data rates: 110, 134.5, 150 or 300. The typewriter in the printer mode is supposed to print 17 characters per second, so only the two fastest data rates will produce the maximum throughput. The only other interface option provided, or required, is a jumper that can select a high or low true level for the ready-to-send (RTS) handshaking signal.

The options set up in the Oly were compatible with the serial port on my computer, and I simply plugged the machine in, made the proper device selection in the CP/M operating system, and I was in the word processing business for real.



An 8½-inch page is dwarfed inside the 15-inch-wide carriage of the Olympia ES-100 typewriter/printer. A Mostek 3870 microprocessor interfaces with the electronic keyboard and the stepper-motor driven mechanical portions of the printing mechanism. Margin and tab settings are stored in CMOS memory with a battery to retain the data when the typewriter is turned off.



Removing four screws from the back of the typewriter provides access to the electronic components. The original Olympia microprocessor controller is on the larger of the two circuit boards. The additional serial interface from Dataface, Inc. is on the smaller board and connects to the controller through the wide ribbon cable plugged into the microprocessor socket. The 3870 microprocessor is then moved to the Dataface circuit board.

Since this is a typewriter with an add-on interface, the machine is fully dual-function. Turn the power switch on and it is a typewriter. Plug in your computer RS-232 serial interface cable and it is a printer—not even any switches to throw. The typewriter will accept characters from the keyboard or the computer at the same time. This turns out to be a useful feature.

As a typewriter, the Olympia is a beautiful machine. It is quiet, and produces perfect copy. The lift-off correction feature is perfect for typists like me with a high error rate. Make a mistake and all you have to do is press the correction key. The typewriter backspaces, selects the correction ribbon, strikes the same character you had previously pressed in error, and the letter is lifted right off the paper by the correction ribbon. Then all you have to do is press the right key.

The correction system remembers the last eight keystrokes, and successive applications of the correction key produce another backspace and erasure, up to the limit of eight. You can also manually position the printhead anywhere on a page and lift off any character previously typed in error.

The lift-off correction ribbon only works with the compatible carbon ribbon. Another correction ribbon, which covers errors with white ink, works with other ribbons, but doesn't do such a neat job. In addition to these, Olympia provides additional selections of fabric and multi-use carbon ribbons.

Several type styles are available, in both 10- and 12-pitch, although not the selection to be found on the more popular changeable font typewriters. The typewheel (Whisperdisk, in Olympiaese) supplied with the machine was not to my liking, producing very thin line characters. A new boldface wheel, combined with the multi-use carbon ribbon, produces a satisfying bold type.

With this fantastic typewriter sitting on its stand next to my desk, I no longer dread letter writing. I make excuses to write more. I just sit back, prop my feet up on the case containing my now-neglected SCM, and type, type, correct, type, correct. . . .

Aggravation

The ES-100 was designed as a type-

writer, not a computer output printer. When the serial interface was added, Dataface wisely took precautions to prevent operating the typewriter mechanism faster than it was designed to run. This is most noticeable in the delay involved with each line feed. Much more than the character typing rate, this delay and the machine's normally slow carriage return speed seem to slow things down excessively when printing double-spaced text.

Not so wise, in my opinion, were some of the other decisions made in the interface design and programming. Most frustrating is the use of the carriage return. The Dataface program ignores the ASCII line feed character, and receipt of a carriage return character produces carriage return/line feed together. This makes underlining impossible from the word processing program I am using, which wants to carriage-return only and make a second pass over the line for underlining.

This same inability produces a curious situation. The typewriter has keys for one-half line space up or down, permitting the typing of subscripts and superscripts. Olympia calls these functions "index" for down a half line, and "reverse index" for up half a line. The Dataface program will accept and execute reverse index, putting the paper in position for the typing of a superscript, but you can't get back down to the normal character position! "Index" works from the keyboard, but not from the computer.

At first I thought that I could modify my printer driver routine in the computer and patch in a simple routine consisting of a line feed followed by another reverse index and get back to where I started. That was when I discovered the fact that the line-feed character is ignored by the Dataface software. This one discrepancy makes both underlining and sub- or superscripting impossible, no matter how smart the programmer.

A call to Dataface produced the information that things are as they are because that is what the customers demanded. I was assured that Dataface could supply me with any set of controls I wanted. So I wrote up a nice two-page report detailing what my Olympia was doing and what I wanted it to do and fired it off to Da-

Keytop	Function	Available To Computer?
REV TAB	Back up to previous tab setting	yes
REPEAT	Repeat last keystroke	yes
HALF SPACE	Space 1/2 character width forward	yes
EXPRESS	Carriage return without line feed	no
INDEX	1/2 line space down (subscript)	no
REV INDEX	1/2 line space up (superscript)	yes
X	Backspace and correct character	yes

Table 1. Extra functions not normally found on typewriters are made possible by the microprocessor controller in the ES-100. Key labels and their actions in the typewriter mode are listed. Not all of the functions are available from the computer interface.



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CORRECTIONS

Quizzical

The Micro Quiz program as published in the February 1982 issue was incorrect. The following program lines should be substituted.

```
120 FOR I = 1 TO 4
130 FOR J = (I + 1) TO 5
135 A(I) = J:A(J) = I
140    IF A(I) = A(J) THEN 160
150       T = A(I):A(I) = A(J):A(J) = T
160 NEXT J
170 NEXT I
```

* * *

The Asian language software attributed in our January issue to The China Institute is available from Asiagraphics, 141 Mt. Sinai Ave., Mt. Sinai, NY 11766.

taface. Three months and several follow-up prompts later I've had no reply to my requests.

Since the machine will accept keystrokes as well as serial characters at the same time, I have worked around the problem in an unsatisfying manner. When text requires underlining or half-line spacing, I'm forced to insert pauses into the word processor text, and manually type in what should be typed automatically.

Exasperation

A much more serious problem lurks within my ES-100, waiting to catch the unwary proofreader. About once in 20 pages an entire line of text will simply disappear. This is almost invariably one line, from carriage return to carriage return.

It's obviously a software problem in the Dataface interface, since it never occurs when my dot-matrix line printer is connected to the same computer port, running the same software.

When a system such as I am using consists of a computer produced by one supplier, software by another, a printer by someone else and a printer interface from yet another source, it is easy for any one of the suppliers to claim that the trouble belongs to one of the other guys. What I was not prepared for was the rapidity with which the finger-pointing occurred when troubles first arose.

> I love my Oly
> and live with
> its idiosyncrasies.

I called Olympia to report a problem that had absolutely nothing to do with the computer interface or operation. All the symptoms point to a mechanical problem. I described the symptoms, and not three seconds of thought elapsed on the other end of the phone line before I was curtly informed that the problem *had* to be in the Dataface circuitry.

Another time, another problem, obviously *in* the Dataface portion of the machine, and this time it was the Dataface rep who responded instantly with the statement that the trouble was in Olympia's department. No time for thought—just point the finger.

So what's new? With a decade and a half of computer system experience behind me I have seen a lot of this sort of thing, and sometimes the finger-pointing is justified. But it was not in either of these instances. I think I have enough ability and experience to be able to localize troubles to either the mechanical or electronic part of a system. I would expect the supplier of either, or both, to at least consider for a minute that his end of the system might possibly be at fault. Such consideration was totally lacking.

I love my Oly (both kinds) and have learned to live with its idiosyncrasies. I am not happy having to reprint whole pages of text, however, and I am not happy knowing that if a problem I can't work around does crop up, I am going to have to fight (and probably disassemble the interface from the typewriter) to get it fixed. For these reasons I can't recommend that you buy this Olympia/Dataface combination.■

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Read why Romberg Integration, in a ten-line Basic routine, is a simple, effective solution to practical mathematical problems.

A Basic Solution To Definite Integrals

By Harry L. Pruetz

Romberg integration is a simple, effective numerical method for determining values of integrals. It is comparatively easy to program in Basic and has a wide range of uses. The method yields additional information on the integrand (the function being integrated), besides a single numerical result. A programmer experienced with the method may even use Romberg integration when its conditions are not strictly met.

Solutions of practical mathematical problems often lead to the integration of functions which are far beyond problems in a college textbook on integral calculus. The tables of integrals in calculus or mathematical reference books often may not contain the exact form needed for a particular problem, leading to change of variables and other methods which may obscure the form of the original problem. The integrals may be given in lower-order recursive forms, series of terms, or mathematical functions which are not elementary, such as gamma and beta functions.

There are many numerical integration methods for computers which may be used instead of exact analytic methods. Also, the evaluation of a definite integral in a computer program may be only one step of a more involved computation in which either time or accuracy can be critical. One of the attractions of Romberg integration is the relatively simple relation between time and accuracy.

Many factors must be considered when discussing numerical integration methods. Functions in the integrand may be measurements which are not even represented as mathematical functions. Intervals may be finite or infinite. Functions may contain singularities (e.g., 1/x is singular at x = 0). Different-sized subintervals may be used and weights used to multiply ordinates (y-coordinate values) at each abscissa (x-coordinate value).

One of the attractions of Romberg integration is the relatively simple relation between time and accuracy.

Methods which use equally spaced abscissas are called *Newton-Coates quadrature formulas*. Examples are the trapezoidal rule and Simpson's rule. The trapezoidal rule uses a straight line between two ordinal points to produce a trapezoid with the approximate area under the curve over the subinterval. Simpson's rule uses a parabola defined by three consecutive ordinates as the approximate area of each subinterval.

Another interpretation of the trapezoidal rule is a rectangle with ordinate equal to the average of the endpoint ordinates of each subinterval. This is also the average of the *lower Riemann sum* and the *upper Riemann sum*. It has been proven mathematically that these sums for a continuous bounded function over a bounded interval converge to the integral as the number of subintervals increases to infinity. A computer routine using the trapezoidal rule could supposedly increase the number of subintervals automatically until a desired accuracy was obtained. However, there is round-off error when a floating-point format is used since real numbers and functions are being evaluated and summed.

Richardson Extrapolation

Richardson extrapolation combines two different approximations to give a third approximation which is better if conditions on the function and the combination are satisfied. For a function f(x) over the inverval (a,b), let f0, f1, and f2 represent f(x) evaluated at abscissas a, a + (b − a)/2, and b. The trapezoidal rule for h = (b − a) gives the integral approximation I = (b − a)(f0 + f2)/2. The trapezoidal rule for h = (b − a)/2 gives the integral approximation

J = ((b − a)/2)((f0 + f1)/2 + (f1 + f2)/2) = ((b − a)/2)(f0/2 + f1 + f2/2).

Take

K = (4J − I)/3 = ((b − a)/2)(2f0 + 4f1 + 2f2 − f0 − f2)/3 = ((b − a)/6)(f0 + 4f1 + f2).

The result of the extrapolation of two trapezoidal approximations gives the parabolic approximation (Simpson's rule) of an integral.

Smaller subintervalues and more applications of Richardson extrapolation will result in approximations which are *mathematically* equivalent to higher order integration approximations. These higher order approximations have widely varying coefficients for consecutive ordinates of a function. Because of round-off error,

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programs which use these methods give approximations which are *computationally* less accurate than expected. The use of successive applications of the trapezoidal rule together with Richardson extrapolation to give integration approximations which are mathematically correct and computationally accurate is called *Romberg integration.*

Romberg discovered and verified a simple, effective, and intuitive approach to numerical integration—the "binary search" of integration methods. Although Romberg integration may not be the best in any given application, it can be used in the first version of any program requiring numerical integration to help find the trouble spots in the intervals of integration and to help determine tradeoffs between accuracy and speed.

A detailed explanation of Romberg integration is given on pp. 121-124 in Anthony Ralston's *A First Course in Numerical Analysis*, published by McGraw-Hill. However, references are made to different sections of the book and other books for detailed derivation and verification of Romberg integration. Because the success of the method depends mostly on the characteristics of the function being integrated, extreme examples of applications will be discussed below. Notation similar to that in Ralston's book will be used here, with subscripts modified to have a different meaning.

For an integral of f(x) over an interval (a,b), use a matrix T(10,10) of elements such that the left column is calculated as follows:

$T(0,0) = (B-A)(F(0)/2 + F(1024)/2)$

$T(1,0) = ((B-A)/2)(F(0)/2 + F(512) + F(1024)/2)$

....

$T(10,0) = ((B-A)/2^{10})(F(0)/2 + F(1) + \ldots + F(1023) + F(1024)/2)$

where

$f(0) = f(a)$, $F(1) = f(a + (b-a)/1024)$, $F(2) = f(a + 2(b-a)/1024)$,

and so forth. Then, for each row K = 1 to 10, calculate:

$T(K,1) = (4T(K,0) - T(K-1,0))/3$

$T(K,2) = (16T(K,1) - T(K-1,1))/15$

....

$T(K,K) = (4^K T(K,K-1) - T(K-1,K-1))/(4^K - 1)$

In general, each extrapolation M = 1 up to M = K is defined: $T(K,M) = 4^M T(K,M-1) - T(K-1,M-1))/(4^M - 1)$

The matrix of trapezoidal approximations and extrapolation approximations to an integral is triangular (all T(I,J) with J>I are 0) with each element T(I,J) calculated from elements to the left and above. The final *answer* is T(10,10). In practice, a computer routine will iterate on the row index and need only calculate rows as long as some convergence condition is not satisfied.

A general-purpose Basic routine for Romberg integration is given in Listing 1. Only one row RT of the matrix T is saved during each iteration RK. Applesoft Basic (and standard Dartmouth Basic) allows one-dimensional arrays of ten or less elements to be used without being dimensioned. For well-behaved bounded functions on bounded intervals, ten iterations are usually sufficient for accuracy close to the round-off error of Applesoft Basic on an Apple II microcomputer. For RK = 10, the trapezoidal rule for the simplest of integrands requires more than ten seconds.

Since Applesoft Basic uses a 32-bit normalized "hidden bit" format for floating-point numbers, round-off error is 2^{-32} so that $1 + 2 \times 10^{-10}$ rounds off to 1. A first approximation to the round-off error for 1024 subintervals is $(64 \times 10^{-10})I$, where I is the integral approximation of a function. When using a relative-error convergence test value less than 10^{-9}, it is a good idea to test for *divergence* of approximations to prevent infinite looping.

```
10 RO=0: R1=1: R2=2: R4=4: RZ=1: IF RA>RB THEN RZ=-1
11 RI=(FN R(RA)+FN R(RB))/R2: RT(RO)=RZ*(RB-RA)*RI
12 FOR RK=R1 TO 10: RN=R2^RK: RS=RI: RD=RZ*(RB-RA)/RN
13 FOR RJ=R1 TO RN-R1: RS=RS+FN R(RA+RZ*RJ*RD): NEXT: RS=RD*RS
14 RC=R1: FOR RL=RO TO RK-R1: RP=RT(RL): RT(RL)=RS: RC=R4*RC:
    RS=(RC*RS-RP)/(RC-R1): NEXT: RT(RK)=RS: IF RK<=R4 THEN GOTO 17
15 RG=ABS(RP-RS): IF RG>RF THEN RS=RP: GOTO 19
16 IF ABS(RG)<=ABS(RS)*RE THEN GOTO 19
17 RF=ABS(RP-RS): NEXT RK
18 PRINT "ROMBERG INTEGRATION FAILED": PRINT "RP="; RP: FOR RK=0
    TO 10: PRINT "RT("; RK; ")="; RT(RK): NEXT: RK=10: STOP
19 RI=RS
```

Listing 1. Romberg integration routine.

```
1 DEF FN R(X)=EXP(2*X)
2 INPUT "RA=";RA
3 INPUT "RB=";RB
4 INPUT "RE=";RE
5 GOSUB 10
6 PRINT "THE INTEGRAL OF F(X) OVER THE INTERVAL
   FROM "; RA; " TO "; RB; " EQUALS "; RS; "."
7 END
```

Listing 2. An example of a main program that calls the routine in Listing 1. (Remember to change line 19 to read 19 RI = RS: RETURN.)

The Romberg Routine

All variables used in the routine begin with R. R0, R1, R2, and R4 in line 10 are constants assigned the values 0, 1, 2, and 4 at the start of the routine to avoid Applesoft number conversion inside loops of the routine. RZ is +1 or −1 depending on the direction of integration over an interval. In cases where the integrand is decreasing in magnitude, integration should start at the upper limit and proceed to the lower limit to obtain minimum round-off error. Example 2 below demonstrates the advantage of this.

FN R as used in line 11 is an Applesoft Basic function which is to be used as the integrand and must be defined outside the routine (see line 1 of Listing 2). RA and RB are the lower and upper limits of integration set outside the routine. RI in line 11 is the initial value of the average of ordinates over an interval. RT(R0), the first approximation, is immediately

calculated in line 11 before any iterations are started.

The main iteration loop extends from line 12 through line 17 and uses RK as the iteration counter.

RN in line 12 is 2 (R2) raised to the power RK and is the number of subintervals used at the given iterative level. RS, the ordinate sum, is initialized to RI in this line. RD is the absolute difference between subinterval abscissas.

The actual summation loop is contained in line 13. RJ is used as the subinterval counter. An abscissa, RX, could be initialized to RA and during each iteration on RJ, RX could be set to RX+RZ*RD. This would introduce some round-off error in RX for large RJ. A better method is to calculate each abscissa directly as RA+RZ*RJ*RD as in line 13. The last statement RS=RD*RS gives the actual trapezoidal approximation of the integral at level RK.

The RC set to 1 in line 14 is the running power of 4 used for Richardson extrapolation. RP, RS and elements of RT(RK) are used to save the trapezoidal approximation and all extrapolations for iteration RK. The test on RK size allows the routine to establish some convergence values before convergence or divergence is tested. If RK is less than 4, no tests are made. This allows the Romberg integration routine to operate on periodic integrand functions which may contain identical ordinates for 1, 2, 4 or 8 subintervals.

Line 15 is a divergence test. It determines whether the absolute difference between T(RK,RK) and T(RK−1,RK−1) is greater than the absolute difference between T(RK−1,RK−1) and T(RK−2,RK−2). If it is, the integral approximation from the previous iteration is used as the answer.

Line 16 tests for convergence according to the relative error factor, RE, set outside the routine. The strictest test is RE=0, which would require that RP=RS or T(RK−1, RK−1)=T(RK,RK) to 32 bits of accuracy in Applesoft Basic. For well-behaved integrands, an RE of around 10^{-10} is more practical. For extreme cases, much larger factors closer to 10^{-5} are necessary. Factors close to 1 are a misapplication of the routine and will very likely give meaningless results.

Line 17 establishes the absolute convergence difference, RF, for the next iteration. The NEXT RK statement is the iteration end.

If the integration approximations do not converge by the time RK is 10, line 18 is executed. If the information printed indicates an answer which is tolerable, an Applesoft Basic CONT command causes RI=RT(10) to be used.

Line 19 uses variable RI to return the Romberg integration answer to the user's program. Information relating to the integration may be retrieved from the variables RK, RS, RP and RG or printed in line 19 before the Return statement.

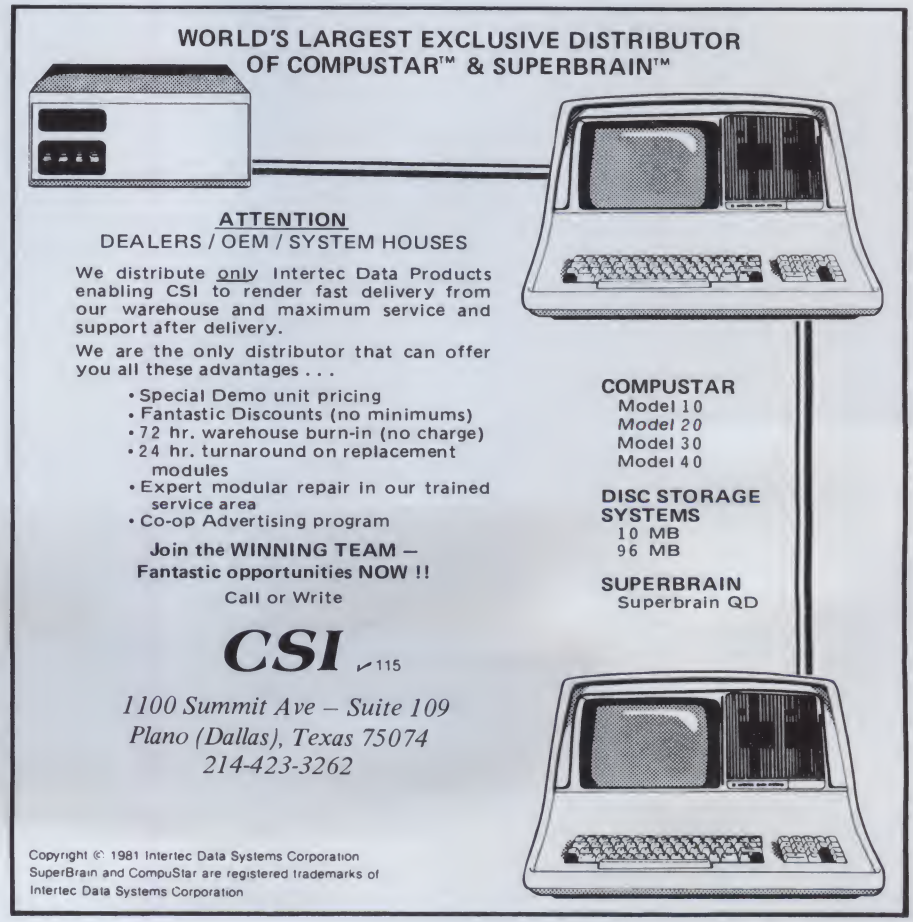
In summary, 20 variables and one function, FN R, are used in the routine. RA, RB and RE are set before a GOSUB 10. Afterwards, RI is the result with RG, RK, RP and RS containing extra information about the integration process. Variables used during the routine include R0, R1, R2, R4, RC, RD, RF, RJ, RL, RN, RT and RZ.

In most cases, whether the routine may be applied to a given function is best determined by visual inspection of a function plot using high-resolution graphics. Besides determining whether the interval should be reduced to several smaller intervals, the order of integration can be selected to give minimum round-off error. The mathematical error term for Romberg integration depends on higher derivatives of the integrand function. A plot which reveals singularities (e.g., 1/x at x=0) or quickly varying functions (e.g. sin(64x) from 0 to π) indicates that there will be slow convergence.

Examples

The integral for the gamma function of order 2 may be expressed in two different forms. One is the integral from 0 to 1 of log(1/x). Another is the integral from 0 to infinity of $x(e^{-x})$. Either form should give a 1. However, the first form is unbounded at 0 and the second form has an unbounded upper limit. These two forms are chosen as examples 1 and 2 for Romberg integration and the approximation matrices are given in Tables 1 and 2.

Since there is a singularity at 0 for log(1/x), a simple application of the Romberg integration routine with *RA*=0 will not work. Visual inspec-



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```
ROMBERG INTEGRATION FAILED
RP=.99947997
RT(0)=.999472329
RT(1)=.999153247
RT(2)=.999124322
RT(3)=.999118305
RT(4)=.999116865
RT(5)=.999116508
RT(6)=.999116419
RT(7)=.999116397
RT(8)=.999116391
RT(9)=.99911639
RT(10)=.99911639
```

Sample run 1. Result of the routine in Listing 1 if the function being integrated is log(1/x) over the interval from 10^{-4} (1E−4) to 1.

```
RA=2
RB=3
RE=1E-10
THE INTEGRAL OF F(X) OVER THE INTERVAL
FROM 2 TO 3 EQUALS 174.415322.
```

Sample run 2. Sample run of program in Listing 2.

RK	RT(0)	RT(1)	RT(2)	RT(3)	RT(4)	RT(5)
	RT(6)	RT(7)	RT(8)	RT(9)	RT(10)	
0	4.60479					
1	2.648844	1.996888				
2	1.742791	1.440773	1.403699			
3	1.329208	1.191347	1.174718	1.171084		
4	1.143068	1.081022	1.073667	1.072063	1.071675	
5	1.060550	1.033043	1.029845	1.029149	1.028981	1.028939
6	1.024609	1.012693	1.011268	1.010974	1.010902	1.010885
	1.010880					
7	1.009297	1.004193	1.003631	1.003480	1.003473	1.003471
	1.003470	1.003471				
8	1.002957	1.000844	1.000620	1.000572	1.000561	1.000558
	1.000557	1.000557	1.000557			
9	1.000430	0.999587	0.999503	0.999486	0.999482	0.999480
	0.999480	0.999480	0.999480	0.999480		
10	0.999472	0.999153	0.999124	0.999118	0.999117	0.999117
	0.999116	0.999116	0.999116	0.999116	0.999116	

Table 1. Integrand log (1/x). RA = 10^{-4}, RB = 1.0 and RE = 10^{-3}.

RK	RT(0)	RT(1)	RT(2)	RT(3)	RT(4)	RT(5)
	RT(6)	RT(7)	RT(8)	RT(9)	RT(10)	
0	2.7e−10					
1	1.629797E−4	2.173062E−4				
2	.044763818	.059630764	.063591661			
3	.393313369	.509496541	.539487593	.547041497		
4	.779584113	.908341030	.934930663	.941207537	.942753286	
5	.938568075	.9915622729	.997110842	.998097829	.998320928	.998375247
6	.984200979	.999411947	.999935228	.999980060	.999987441	.999989070
	.999989464					
7	.996021892	.999962197	999998880	.999999891	.99999968	.999999981
	.999999983	999999984				
8	.999003689	.999997621	.999999982	1.00000000	1.00000000	1.00000000
	1.00000000	1.00000000	1.00000000			
9	.999750811	.999999851	1.00000000	1.00000000	1.00000000	1.00000000
	1.00000000	1.00000000	1.00000000	1.00000000		

Table 2. Integrand xe^{-x}. RA = 28.0, RB = 0.0 and RE = 6×10^{-10}.

tion of the plot of log(1/x) reveals that much of the area under the curve is around x = 0. Consequently, RA was set to 10^{-4}, RB was set to 1 and RE was set to 10^{-3} to give the converging values shown in Table 1. It is known mathematically that the gamma function of order 2 is exactly 1.0. The final answer of 0.999116 by the Romberg integration routine demonstrates how well the routine operates on even a singular function.

This integral is also an example of a case in which Romberg integration is worse than the trapezoidal rule because of the singularity of the integrand and all higher derivatives at x = 0. For the form of the integrand and the limits, the trapezoidal rule at RK = 10 gives 0.999472 or an error of 5.28×10^{-4}, which is a generally unacceptable relative error for numerical integration. Smaller values of RA than 10^{-4} do not give any improvement because the large ordinate at RA will only introduce round-off error as the smaller ordinates are added onto the sum.

Since the upper limit of the second form of the gamma function of order 2 is infinity, a practical upper limit must be chosen. The maximum value of $x(e^{-x})$ is .387 at x = 1. The value of $x(e^{-x})$at x = 24 is close to 10^{-9} or about 2^{-31}. At x = 28, the value has decreased to about 2×10^{-11}, which is negligible compared to the maximum value. This value of x qualifies as a practical upper limit for the integral.

Since the integrand $x(e^{-x})$ decreases for large abscissas, integration is best performed from the upper to the lower limit to avoid excessive round-off error when summing ordinates. As can be seen from Table 2, RA = 28.0, RB = 0.0, RE = 2^{-32}, and FN R(X) = X*EXP(−X) gives convergence to 1.0 at RK = 9. A plot of the integrand function demonstrates the magnitude of ordinates to be expected and the approximate length of the integration interval necessary to get an accurate approximation. The values in Table 2 show the answer converging to 1.0 much more rapidly than in Table 1. The absolute convergence difference, RG, is actually 0 after only 9 iterations.

Table 3 is an example of round-off error caused by integrating from the lower limit RA = 0 to an upper limit RB = 32 using RE = 10^{-9} and the same integrand FN R(X) = X*EXP(−X). The "correct" answer actually ap-

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pears at RK = 8. Because of the practical convergence and divergence criteria which cannot guard against this kind of round-off error, the routine returns a result which is mathematically in error by 2×10^{-9}. However, the absolute convergence difference as calculated by the Romberg integration routine is 10^{-9}.

Two other cases were run for $x(e^{-x})$, but are not tabulated here. RA = 0, RB = 24 and RE = 10^{-9} gave the approximation 0.999999994 after ten iterations. RA = 0, RB = 28 and RE = 10^{-9} failed after ten iterations with a result of 0.999999988. Both of these cases demonstrate how round-off error can cause relatively poor results using the Romberg integration routine. These cases also show that low convergence test values do not guarantee the same level of accuracy in the results.

The last example, as tabulated in Table 4, is a different type of slowly converging Romberg integration. The function 15xsin(114x) changes sign 57 times between 0 and $\pi/2$. RA = 0 and RB = 1.570796327 are chosen as limits since the amplitude of this periodic function increases with x. The relatively high RE = 10^{-5} is necessary because subinterval resolution is not sufficient to even get the correct sign until RK = 6.

This integral can be evaluated using integral tables to give:

$$\left[\frac{15\sin(114x)}{114(114)} - \frac{15x\cos(114x)}{114} \right]_0^{\pi/2}$$

$$= \frac{-15(\pi/2)\cos(\pi)}{114} = .206683727$$

The result in Table 4 of .206683708 is actually within 10^{-9} relative error of the exact solution although the Romberg integration routine calculates an error of 6×10^{-6} on the RK = 10 iteration. Higher accuracy could be obtained by using several intervals and a smaller RE for each interval. Too many such intervals would introduce extra round-off error in the final sum so that the actual error would be more than the RE for any specific interval.

The entire Romberg Integration routine requires about 450 bytes of memory, but actual programs which use the routine typically require from 1000 to 4000 bytes of program memory.

RK	RT(0)	RT(1)	RT(2)	RT(3)	RT(4)	RT(5)
	RT(6)	RT(7)	RT(8)	RT(9)	RT(10)	
0	6.48405E-12					
1	2.88090E-05	3.84120E-05				
2	.021484020	.028635757	.030542247			
3	.304089319	.348288419	.422931930	.429160327		
4	.724061661	.864053108	.895104087	.902598840	.904455505	
5	.920673594	.986210908	.895104087	.995930017	.996296171	.996385947
6	.979424523	.999008166	.999861316	.999948722	.999964481	.999680670
	.999689420					
7	.994807902	.999935695	.999997530	.999999692	.999999892	.999999270
	.999999935	.999999936				
8	.998698934	.999995944	.999999961	.999999999	1.00000000	1.00000000
	1.00000000	1.00000000	1.00000000			
9	.999674542	.999999745	.999999998	.999999999	.999999999	.999999999
	.999999999	.999999999	.999999999			
10	.999918622	.999999982	.999999998	.999999998	.999999998	.999999998
	.999999998	.999999998	.999999998	.999999998		

Table 3. Integrand xe^{-x}. RA = 0.0, RB = 32.0 and RE = 10^{-9}.

RK	RT(0)	RT(1)	RT(2)	RT(3)	RT(4)	RT(5)
	RT(6)	RT(7)	RT(8)	RT(9)	RT(10)	
0	0					
1	9.25275413	92.3370055				
2	11.169062	11.8078313	11.772553			
3	-.46012194	-4.336517	-5.4128065	-5.6855899		
4	-1.4093143	-1.725712	-1.5516581	-1.4903700	-1.4739181	
5	-1.6162322	-1.685205	-1.6825044	-1.6845813	-1.6853429	-1.685550
6	.050172040	.605640118	.758363116	.797107044	.806839155	.809275306
	.809884543					
7	.171820536	.212370035	.186152030	.177069314	.174637793	.174019806
	.173864676	.173825854				
8	.198186739	.206975474	.206615836	.206940659	.207057801	.207089492
	.207097568	.207099596	.207100104			
9	.204572544	.206701145	.206682856	.206683920	.206682913	.206682422
	.206682416	.206682414	.206682414	.206682414		
10	.206156725	.206684785	.206683695	.206683707	.206683703	.206683708
	.206683708	.206683708	.206683708	.206683708	.206683708	

Table 4. Integrand 15xsin(114x). RA = 0, RB = $\pi/2$ and RE = 10^5.

One Application

One typical application of Romberg integration is the calculation of coefficients for Chebyshev polynomial approximations for elementary functions. For example, evaluating the coefficients of the Chebyshev polynomial approximation for e^x. The exact solution is a hyperbolic Bessel function, which would have to be evaluated numerically anyhow by a special routine. Other polynomial approximations would require mathematical manipulation and further special routines. Using the Romberg integration routine to numerically integrate the different integrals involved leaves only the simple manipulation of the integrand, lower and upper limits, and convergence accuracy to obtain the desired accuracy.

Note that the purpose of Chebyshev polynomial expansions for functions such as the sine, cosine and exponential functions are for efficiency. These coefficients are close to the coefficients in Taylor series expansions. The series are much shorter than Taylor series for a given accuracy, but are valid only for fixed intervals. Computer routines which use the Chebyshev expansions are much faster and the routines require about the same amount of time for all arguments. The Chebyshev program printed convergence accuracy and iteration number (RE and RK) for each numerical integration to give an indication of how difficult each integrand was to integrate.

Of course, many other applications of the effective Romberg method of numerical integration are possible. ■

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The North Star ADVANTAGE™ is an interactive integrated graphics computer supplying the single user with a balanced set of Business-Data, Word, or Scientific-Data processing capabilities along with both character and graphics output. ADVANTAGE is fully supported by North Star's wide range of System and Application Software.

The ADVANTAGE contains a 4 MHz Z80A® CPU with 64Kb of 200 nsec Dynamic RAM (with parity) for program storage, a separate 20Kb 200 nsec RAM to drive the bit-mapped display, a 2Kb bootstrap PROM and an auxiliary Intel 8035 microprocessor to control the keyboard and floppy disks. The display can be operated as a 1920 (24 lines by 80 characters) character display or as a bit-mapped display (240 x 640 pixels), where each pixel is controlled by one bit in the 20Kb display RAM. The two integrated 5¼ inch floppy disks are double-sided, double-density providing storage of 360Kb per drive for a total of 720Kb. The n-key rollover Selectric style keyboard contains 49 standard typewriter keys, 9 symbol or control keys, a 14 key numeric/cursor control pad and 15 user programmable function keys.

The attractive desk top chassis contains six slots for plug-in option cards: a parallel interface for printer or other parallel devices, a serial (RS-232C) port or a North Star Floating Point Board (FPB) for substantial computational performance increase. Sufficient power (115V or 230V, 60 or 50 Hz) is also contained within the light weight chassis.

Included with the ADVANTAGE system is a system diskette containing a Business Graphics package, a complete system diagnostic program and a Graphics Demo package.

This powerful, compact and self-sufficient computer is further enhanced by a broad selection of Systems and Application software. For the business user North Star offers proprietary Application Software modules controlled by North Star's proprietary Application Support Program (ASP). For a wide variety of commercial, scientific or industrial applications North Star's graphics version of the industry standard CP/M® is offered. For the computation-intensive or graphics-intensive application North Star's powerful G-DOS with G-BASIC provides a rich set of BASIC extensions that exploit the ADVANTAGE graphics features. The following is a more detailed description of these three system software options:

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North Star ASP and Application Modules

The North Star Application Support Program (ASP) is a high performance operating system that includes support for the ADVANTAGE features, two Quad capacity (360Kb per diskette) floppy disk drives and a serial or parallel printer (matrix or letter quality).

ASP manages these ADVANTAGE resources and provides an Indexed Sequential Access Method (ISAM), Sequential and Random File Management for the North Star proprietary Application Software Packages listed below:

ACCPAC™	NorthWord™	—Word Processing
OrderEntry/Invoices	MailManager™	—Mailing List Management
InventoryControl		
AccountsReceivable	InfoManager™	—Data Management
AccountsPayable		
GeneralLedger		

(ASP is included within each package and need not be purchased separately.)

These Application Software modules are all written in a derivative of the C programming language and include options that allow the modules to be customized. A unique Application Development System (ADS) is available for those systems developers who require facilities to develop their own additional application modules.

North Star Graphics CP/M

Graphics CP/M is a compatible enhancement of CP/M, the industry standard operating system for developing and executing programs on floppy disk based Z80 systems. Graphics CP/M is a powerful superset of CP/M that allows the user to not only make full use of the extensive graphics capabilities of ADVANTAGE but also to use CP/M compatible software on the ADVANTAGE. With the appropriate interpreter or compiler, programs can be run in CBASIC,® MBASIC,® FORTRAN or COBOL or any other CP/M compatible language.

Graphics CP/M performs necessary services for application programs such as managing diskette files, controlling peripheral devices, allocating disk space, managing the graphic display and providing an easy to use operator interface. Up to 64 files may be allocated on each of the Quad capacity diskettes (338Kb capacity per

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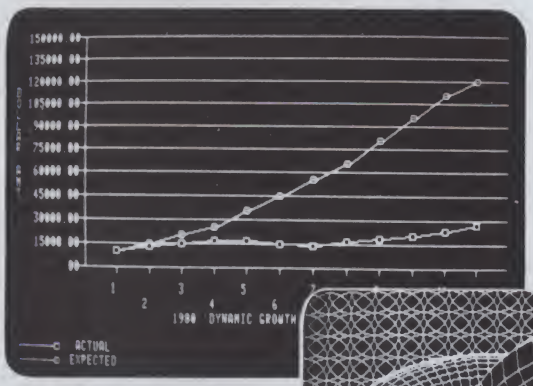
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diskette). Graphics CP/M controls any RS-232C serial printer at 300 to 19,200 baud. The graphic display is controlled in both Character Display Mode (80 characters by 24 lines) and in Graphics Mode (240 x 640 pixels). Graphics Mode includes two sets of functions: geometric functions and graphics support functions. The four geometric functions: POLYGON, RECTANGLE, ELLIPSE and SPECIAL LINE enable the drawing of points, lines and numerous two dimensional figures (circles, ellipses, rectangles, triangles, pie charts, bar charts, etc.). The three graphic support functions: CLEAR, BLOCK, and CHAR are used to control the display operation.

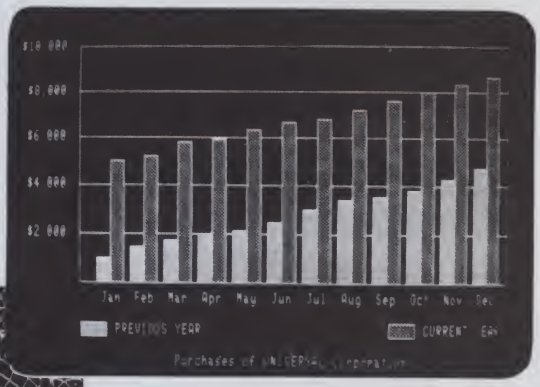
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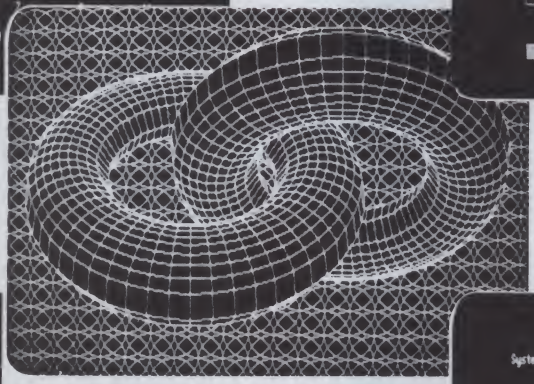
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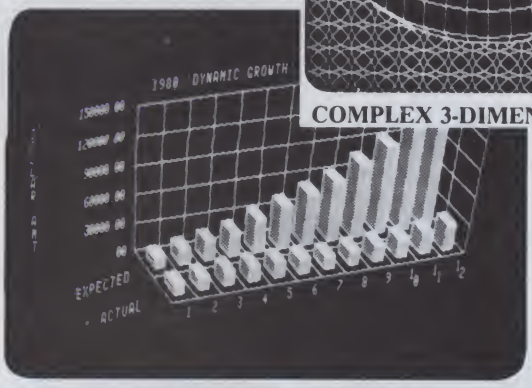
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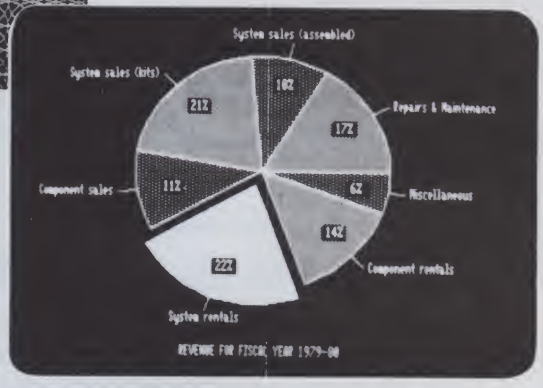
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North Star Graphics BASIC/Graphics DOS (G-BASIC/G-DOS)

G-BASIC is a superset of the well known North Star BASIC and provides a comprehensive set of statements to invoke ADVANTAGE graphics capabilities. In addition G-BASIC provides several noteworthy features over other BASIC implementations that are specifically designed to facilitate scientific, business or industrial applications programming:

- Facilities for programmed error handling.
- Automatic program sequencing (CHAINing).

easy to use operator interface and supports North Star's proprietary G-BASIC, G-BASIC/G-DOS support up to four Quad capacity disk drives (360Kb per drive) with up to 128 files per drive.

G-DOS not only provides compatibility with programs written in BASIC on the North Star HORIZON® computer but also supports the extensions in G-BASIC that permit full utilization of the graphics features of ADVANTAGE. As with Graphics CP/M, G-DOS supports both Graphics Mode and Character Mode, thus providing the same geometric and graphics support functions described above.

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Summary of ADVANTAGE features:

- Fast 4 MHz processor, 64Kb (200 nsec) Dynamic RAM with parity.
- Auxiliary processor (Intel 8035 type) off loads the Z80A by servicing keyboard and floppy disk drive control functions.
- 12 inch green (P31 Phosphor) display with non-glare screen operating in both Character Mode and Bit-Mapped Graphics Mode (240 x 640 pixels) driven by separate 20Kb of fast display RAM.
- Two integrated Quad capacity floppy disks provide 720Kb storage.
- Business graphics software, system self diagnostic software and graphics demo software all included with ADVANTAGE without the requirement for additional operating system software.
- 87 Key Selectric style keyboard includes 15 function keys and a 14 key numeric/cursor control keypad.
- Six I/O bus slots for serial or parallel I/O interfaces or North Star's Floating Point Board (FPB).
- All integrated into a single quiet, compact, attractive desk top enclosure.
- All fully supported by North Star's broad range of software: North Star ASP, G-BASIC/G-DOS or Graphics CP/M—each supporting both the ADVANTAGE Graphics Mode and Character Mode.

ADVANTAGE Specifications

Cabinet
Dimensions
48 cm x 51 cm x 31.5 cm
(18¾ inch x 20 inch x 12½ inch)
Shipping Weight: Approximately 22.5 kg (50 pounds)
Net Weight: 19.5 kg (43 pounds)
Composition: High impact structural foam

Power Requirements
Domestic: 115VAC, (95 to 135VAC), 50/60Hz
International: 115/230VAC, (95 to 132VAC/187 to 265VAC), 50/60Hz
Power 2 amps @ 115V
Consumption: 1 amp @ 230V

Temperatures
Operating: 10°C to 40°C (50°F to 104°F)
Non-operating: −40°C to 60°C (−40°F to 140°F)
Shipping: −40°C to 52°C (−40°F to 125°F)
Humidity:
Operating: 20% to 80% non-condensing
Non-operating and Shipping: 5% to 95% non-condensing

Processor/Memory
CPU: Z80A Microprocessor
Operating speed: 4 MHz
Intel 8035 auxiliary processor for keyboard and disk
Memory: 64Kb Main RAM
20Kb Display RAM
2Kb Boot PROM

Video
Screen: 28 cm (12 inch) diagonal P31 phosphor (green)
High impact, non-glare safety shield
Standard Character Format: 1920 character display, 24 lines by 80 characters
5 x 7 character in 8 x 10 dot matrix
Graphics Resolution: 240 pixels high x 640 pixels wide
Refresh Rate: 50 or 60 Hz, depending on line frequency

Keyboard
Keytops: Sculptured
11° Keyboard angle (Selectric compatible)
Number of Keys: 87
Key Groups: 49 Standard Typewriter Keys
14 Key Numeric Pad with ENTER Key
15 Programmable Function Keys
9 Additional Symbol/Control Keys
Other features: N-key roll-over
Full Cursor Control
Special Shift-Lock Keys
5 Shift Modes
Auto Repeat

Disk
Number of drives: Two floppy disk drives housed in cabinet
Diskettes: Standard 5¼ inch floppy diskettes
512 bytes/sector, 10 (hard) Sectors/track, 35 tracks/side, 2 sides/diskette
Storage capacity: Quad (double-sided, double-density) 360Kb/per diskette (formatted)
Transfer rate: 250K bits/second
Latency: 100 ms (average)
Access Time: Track-to-Track: 5 msec
Track density: 48 tpi
Number of tracks per side: 35
Disk speed: 300 rpm ± 3.0%

Input/Output
Slots for six plug-in boards.
Each board addressed by 16 I/O addresses.
Serial I/O: RS-232C serial port
Current loop option
Asynchronous: 45 baud to 19.2 kilobaud
Synchronous: 2400 baud to 51 kilobaud
Parallel I/O: 8-bit data in and out with three handshake lines for each port. Maximum speed is limited by the processor.
Floating Point Board (FPB): Performs high speed BCD floating point arithmetic: add, subtract, multiply, and divide.
Up to 14 digits of precision (programmable).
Overflow, underflow, and divide by zero status.
Typical 8-digit multiply: 80 microseconds.
Typical 8-digit divide: 156 microseconds.

NEW ADV-IQ-HD5-64K ★

An ADVANTAGE with one quad minifloppy and a 5 megabyte Winchester hard disk, *all self-contained.*

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ADV-IQ-64K List, $3999.....Call

Operating systems
(not included w/ADVANTAGE)
Graphics CP/M 2.2 List, $299.....Call
Graphics NS BASIC/DOS List, $299.....Call
HDSO/ADVANTAGE ★★ List, $299.....Call

System Components
SIO Boards List, $175.....Call
PIO Board List, $200.....Call

★ Graphics CP/M and Graphics BASIC/DOS available in March. NorthStar Application Software available in May.
★★ HDSO/ADVANTAGE is the Hard Disk operating system for NorthStar Application Software on the ADVANTAGE.

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Cromemco announces another sensational first..

Cromemco™
Tomorrow's Computers Today

A combination 68000 (32 Bit Micro Processor) with a Z80 CPU.

Look to Cromemco for single and multi- user systems



There are many good reasons to buy a CROMEMCO system; MiniMicroMart is giving you some especially good reasons for getting a CROMEMCO SYSTEM from us right now.

Among some of the CROMEMCO firsts are:

First to introduce a 4MHz Z-80, S-100 ZPU board.
First to introduce a floppy disk controller that handled both small and large drives.
First to introduce a true 64K system.
First to introduce a S-100 multi-user system (CROMEMCO introduced memory bank selection which has become a quasi standard for multi-user operation).
First to introduce S-100 color graphics (the Dazzler) and now the Super Dazzler is setting new standards for high resolution color graphics.
First to introduce a D/A - A/D board.
First to introduce a full line of software, most at extremely reasonable prices — their CDOS, the first true Z-80 CP/M compatible operating system, an ASSEMBLER, their own 16K BASIC, the first STRUCTURED BASIC, low priced versions of Microsoft FORTRAN and COBOL, and RATFOR. They also introduced low priced word processing and data base management, as well as TRACE.

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Tomorrow's Computers Today— Cromemco™

Who else offers LISP, a 'C' COMPILER, and RPG II?

CROMEMCO was first to introduce a UNIX based operating system for the Z-80. Called CROMIX, it is perhaps the most sophisticated S-100 operating system on the market today and seems to be, as of today's writing, the best multi-user, multi-tasking system. It runs most CDOS and CP/M programs.

CROMEMCO was the first to introduce a S-100 Winchester hard disk system.

And now, CROMEMCO has announced perhaps its outstanding *first* — a combination 68000/Z-80 CPU board which is compatible with current CROMEMCO hardware and the IEEE S-100 Bus. The board will run with *CROMIX,* and will arbitrate as to whether it needs the 32 bit or 8 bit operating system, and turn on the respective CPU. Other boards in the new series will be 256K and 512K RAM boards, as well as a memory management board. The new CPU board lists for $995.

Obviously every micro processor user doesn't have to have this new system, but it should be gratifying to every CROMEMCO user, that he will be able to upgrade his system in the future. It is obvious that the 68000, and *UNIX* type operating systems will be dominating by the end of the decade.

A CS-1, CS-2, or CS-3 are ideal for upgrading to *Z-80 CROMIX* or to the new 68000 (the CS-2 and CS-3 have 21 slots, the CS-1 has 8). The current machines all come with a 4 MHz Z-80 CPU, 64K of RAM, the 16FDC Disk Controller, a printer interface board, and two double-sided, double-density disk drives (the CS-3 has an 8" Persci 299, the others have mini-floppys).

The CS-2 and CS-3 offer an advantage for large systems, since you have the luxury of using every other slot, which gives you ample room for the extra multi-user cables.

MiniMicroMart can supply CROMEMCO systems with a great variety of hard disk drives and operating systems. They include CP/M, MP/M, multi and single user I/OS and Oasis, and others. We have provided interfaces to Morrow hard disks, and even to 96 megabyte CDC Phoenix drives.

In fact MiniMicroMart currently does its order processing and mailing list management on a six user *CROMIX* system, utilizing one HDD11, and two 80 megabyte removeable disk pack Century Trident drives.

CROMEMCO systems are obviously expandable. For example, for those who don't need or can't afford a hard disk, it is nice to know if they can add a string of external 5¼ and/or 8" drives, without any modifications for hardware or software. (This holds true for the CS-0, CS-1, CS-2 and CS-3).

CROMIX UPDATE SPECIAL

CROMIX, CROMEMCO'S version of Bell Labs *UNIX,* offers many advantages. A major one is that it permits every user to have in excess of 60K of RAM area. It runs most CDOS and most CP/M software. (CP/M emulators are available, if needed.)

Currently we are making it very economical to convert to *CROMIX*. The package below will provide for a two user operation.

2-64K Memory Merchant Static ram boards	List $1590
1-*CROMIX* software package	595
1-TU-ART board	345
1-Cable-0	25
2-Cable 2's	50
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MiniMicroMart Package Price **$1599***

*To substitute system group DMB6400 boards, add $300.
*To substitute CROMEMCO 64KZ RAM boards add $600.
*Extra 5% discount will apply to limited inventory.

The New
Cromemco 68000/Z80
CPU Board
— The DPU —

List $995

Our Price $849

256K MSU RAM Board w/error correction, List $1995	$1595
512K MSU RAM Board w/error correction, List $12995	$2495
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With A
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Winchester HDD-5
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64K-Z80A

System One — **$3349**

System Two with dual sided mini floppys, — **$3549**

Multi-User and Hard Disk versions available.

CROMIX®, or MP/M® or OASIS® Systems now available from MiniMicroMart running CROMIX (or MP/M or OASIS) on a CDC Phoenix *(96MB-16 removeable—80 fixed)* hard disk.

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CS-3, features 4MHz CPU w/64K of RAM, NEW
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64KZ Memory Board
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for Multi-user CROMIX® Systems.

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64KZ Dyn. RAM Mem. List $1195	$819
16FDC Disk Cont., DD. List $595	$499
8K Bytesaver II Prom. Prog. List $295	$249
32K Bytesvr. PromCard(2716s) List $345	$295
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IOP Int. I/O Processor. List $695	$589
PRI Printer Inter. Card. List $245	$209
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(specify 8" or 5¼")

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FDR RATFOR incl. Fortran IV. List $395	$335
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SGS Sup. Dazzler Graphics. List $595	$299
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TSS Trace Sys. Simulator. List $195	$95
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SLMR Slidemaster. List $595	$499
SPMR Spellmaster. List $295	$249
FOMR Fontmaster. List $595	$499

CS-O Computer System
w/SCC & MCB-216, List $1295 **$1099**



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Z80 SCC CPU, 64KZ, 16FDC,
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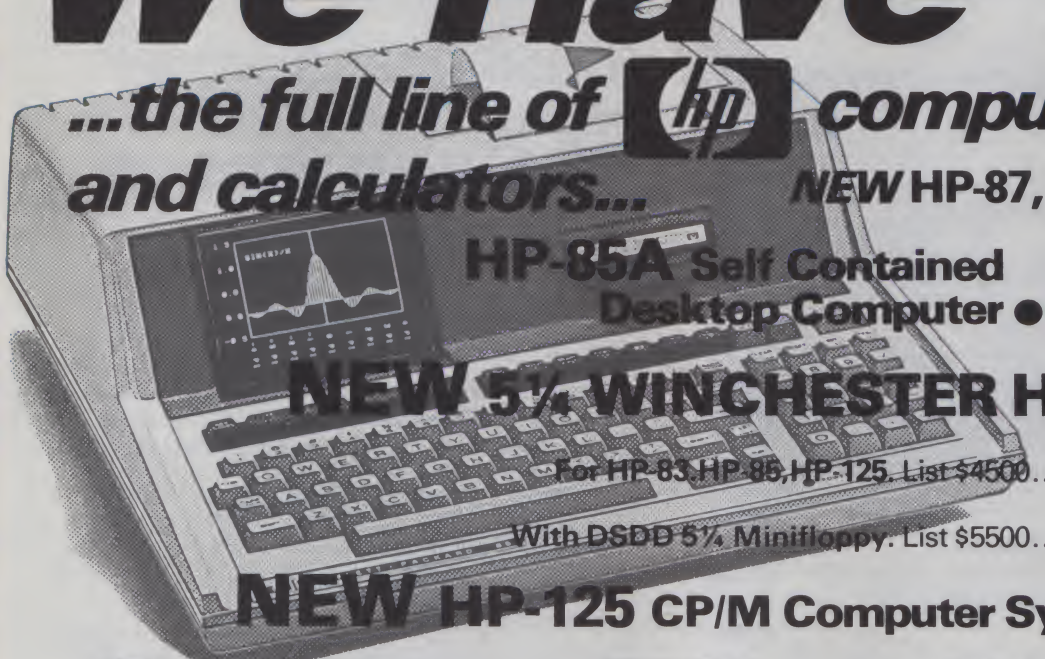
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HP41C.....$189

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HP Introduces The Personal *Office* Computer

It writes letters, draws pictures, helps with financial decisions and even talks to your central EDP system.

The HP 125 is a new kind of personal computer.

It's not for hobbyists, home computing or playing games. It's designed exclusively, and specifically, to help business people do their jobs better.

That's why they call it a Personal *Office* Computer.

The HP 125 is ideally equipped for its work.

To begin with, it has VisiCalc.™ This powerful management software increases the accuracy — and speed — of sales forecasts, budget estimates and financial models. It also helps you analyze "what if" situations and make better management decisions.

To simplify complex computer output, the HP 125 has impressive graphics capabilities. At the press of a button, you'll be able to turn hard-to-understand data into easy-to-understand charts, graphs and even transparencies for presentations. All in color, of course.*

The HP 125 is a powerful word processor, too. It can type, edit and print everything from reports and memos to high quality letters and long documents.

Beyond all this, the HP 125 gives you instant access to the data in other computers — including the HP 3000 and IBM business systems. So while you're working at your own desk, you'll have the latest — and complete — company-wide information at your fingertips.

VisiCalc TM is trademark of Personal Software Inc

Sophisticated but very, very friendly.

You'll feel comfortable working with the HP 125 after only a few hours practice. Because, with all its sophistication, it's designed to be used by people who know nothing about computers.

There's a push-button guidance system that leads you, step-by-step, through every program. And if you make a mistake, special prompting messages tell you exactly what you're doing wrong. What's more, the HP 125 uses simple English-language operating commands, so you don't have to worry about learning computerese.

The HP 125 is also easy to adapt to your specific application needs. Over 100 program packages are available from software suppliers right now, and more are being published every week.

Of course, when you buy an HP 125, you get more than a computer. You get the support of one of the world's largest — and most respected — computer companies. From over 170 service offices located around the world, they make available a wide range of support services. Including a complete in-office support program and a special phone-in consulting service to help you get started.

When performance must be measured by results.

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HP 125 System Summary

The HP 125 personal office computer is an advanced, low cost computer system for business applications. It combines the power of a dedicated Z-80A system microprocessor and 64K bytes of system memory with the full capabilities of an interactive computer terminal with its own microprocessor-based intelligence. These capabilities are packaged in a compact, attractive desktop unit. A built-in 120 cps thermal printer is available as an option. Mass storage is modular and allows the user to configure the system to meet his particular storage requirements. Peripheral devices such as printers and graphics plotters can also be added. Modularity allows the HP 125 to grow in capability as users' needs increase.

SYSTEM FEATURES

System Processor
- Z-80A microprocessor
- 64K Bytes of main memory
- CP/M operating system

Terminal Processor
- Z-80A microprocessor
- 32 KBytes ROM implementing "intelligent terminal" functions
- 16 KBytes RAM for multi-page screen display

Display
- High resolution 12" CRT offers excellent readability
- Enhanced 9 x 15 dot character cell for character clarity
- Upper/lower case characters with displayable control codes
- Display enhancements: inverse video, underline, blinking, and half-bright
- Up to 5 pages of display memory; key-controlled scrolling on a line or page basis

Ease of Use
- Detachable, typewriter-style keyboard
- Separate numeric pad
- Full cursor positioning
- Full editing functions, including insert/delete character and insert/delete line
- Screen labeled function keys
- 8 user defined softkeys with 16-character labels
- Configuration menu for setting terminal parameters

Data Communications
- 2 EIA standard RS232C communication ports
- Asynchronous point-to-point at 110 to 9600 baud
- Full duplex modem support (compatible with Bell 103A modem)
- Character and line mode operation
- Flexible communication protocols

Peripheral Support
- RS232C serial printer
- Specified HP mass storage devices, plotters, and printers
- Integral thermal printer (optional) operates at 120 characters per second.

Reliability and Serviceability
- Go/no-go and diagnostic self tests built in
- Modular construction

VISICALC/125
GRAPHICS/125
WORD/125 word processing
BASIC/125
LINK/125

The HP 125 Model 10 uses dual 5¼" flexible disc drives to provide approximately 512K Bytes of on-line storage. The small flexible discs store information in a high density format. Large amounts of information can be retained on- and off-line on low-cost media. The high performance and reliability of the disc drives let you store program and data files with confidence. Long flexible disc life reduces data storage costs.
The HP 125 Model 20 provides 2.32 million bytes of formatted mass storage on dual 8" flexible disc drives. The built-in controller can recognize if the flexible disc has been recorded on one or two sides. The controller also reads and writes the IBM single-sided, single density format. The drives have been designed for high performance and reliability. Extensive self-tests are initiated at powerup and are accessible to the system processor.

	Model 10 (82901M)	Model 20 (9895A)
Total Capacity (2 drives, formatted)	512K bytes	2.32M bytes
Recording Surfaces per Disc	2	2
Recording Format Density	Double	Double
Tracks per Surface	35	77
Sectors per Track	16	30
Bytes per Sector	256	256
Rotation Speed (rpm)	300	360
Average Access Time (msec.)	187	179

Additional disc drives may be added to either a Model 10 or Model 20 system up to a total of 8 disc drives.

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MORROW DESIGNS

Multi User with a UNIX* Type of Operating System

Decision I, DF5224, 65K
w/dual 400K 5¼" Floppys
$3549

All Systems include CP/M 2.2, w/Microsoft Basic, & WordStar



Decision 1, DF5124
65K Static RAM, 400K Floppy,
5 Meg. Winchester, w/CP/m 2.2
ONLY $4999

Decision 1,
Three User,
195K RAM,
400K Mini Floppy,
5 Meg. Winchester
$6595
Includes MOS Operating System

Decision 1

The Decision 1 has been designed to be the most versatile desk top computer system on the market for 1982. This machine contains the IEEE 696 standard S-100 bus. It is not a single board computer. This machine is cost effective for single users but was designed to expand to fifteen users. You can start with 65K of memory and expand to (1) one megabyte of main memory. You can start with 5¼ inch floppy drives, add 5¼ inch hard disks, eight inch floppies, eight inch hard disks or even fourteen inch hard disks.

The power of the machine lies in six major areas currently:

CPU
Designed to function like an IBM® 370 processor with extended addressing, supervisor control of users, sophisticated *trapping* mechanism and arithmetic floating point processor on board. Dynamic allocation of memory in 4K increments to (1) megabyte adds maximum growth potential. Each of 15 users can have 65K each.

MOS operating system UNIX® + CP/M®=MOS
Our MICRONIX Operating System will run multiple CP/M® packages or multiple Unix level 6 packages simultaneously. It is functionally equivalent to Bell Laboratories Unix®, including file compatability. MOS also will run Wordstar®, or Microsoft Basic, or any standard CP/M applications package. Not one, not two, but (15) fifteen.

DMA Floppy Controller
George Morrow's finest creation. Twelve times the speed of I/O based controllers. Will drive either 8 inch or 5¼ inch floppies and can be programmed to read or write any format. There is a Z80A processor on board to perform DMA transfers and assist in system calls.

DMA Hard Disk Controller
This 5x10 inch DMA Controller for the 5¼ inch or 8 inch hard disk drives is second to none in the world for speed, size and cost. This controller also contains its own microprocessor to control all drive functions. The Signetics 8x300 8 bit microcomputer was used for one primary reason. It has the fastest cycle of any microcomputer on the market today.

Motherboard
The motherboard contains 14 I/O slots, a programmable interrupt controller, real-time clock, parallel daisy-wheel printer port, and (3) three serial ports. This gets you your first three users while using none of your 14 available slots.

Price
Morrow Designs has been a price leader in disk storage memory boards, bus boards, CPUs and I/O boards since 1975.

Specifications, prices, terms subject to change without notice.

Software is not warranted for fitness of purpose.

*UNIX is a trademark of Bell Labs.
**CP/M is a trademark of Digital Research
***Trademark of Micropro
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Z-89 + A-87 Combination **$3279**
Z-90FA **$2695**
Z-37, Two 5¼" Drives(96 TPI) **$1695**
Z-90 + Z-37 Combination **$4239**
Z-47DA, 8" Two Meg. Disk System **$3059**

Systems come w/ CP/M®, MICROSOFT BASIC, SUPERCALC

INTERSYSTEMS

The new Series II CPU Board features a 4 MHz Z-80A CPU and a full-feature front panel. 20-slot actively terminated motherboard, with 25 amp power supply (50/60 Hz operation, incl. 68 cfm fan). DPS-1, List $2,195

CALL FOR PRICE



COMPLETE SYSTEM with InterSystem 64K RAM, I/O Board and double density disk controller board. List $3795

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CS-O/D

A complete 64K Computer with Double Density Disk Controller.
List $2995 ..... Our Price **$2545**
Companion Disk Drive for above, Quad Density, 780 Kilobytes of storage on the two drives.
List $1295 ..... Our Price **$1099**
Complete 64K Disk System ... Our Price **$3644**

SUPERBRAIN



64K Double or Quad Density units available. Uses two Z-80 CPU's. Commercial-type terminal with 12" monitor. Dual double density minifloppies. Over 350 kilobytes of storage (twice that with quad density drives). Two serial RS232 ports, I/O ports standard. Comes with CP/MTM 2.2 operating system. MiniMicroMart can supply a wide range of CP/M development and application software.

w/64K Double Density, List $3495 .. **$2869**
w/64K Quad Density, List $3995..... **$3395**

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TeleVideo

TeleVideo,a leading producer of CRT terminals,has introduced a full line of computer systems. they are designed to be used as stand-alone devices or as part of multi-user distributed process systems. All are competitively priced.

Two of the very interesting systems are self-contained desk-top computers (like the *Superbrain* and the *Advantage*). Very competitively priced is the TS802 with two quad density mini floppies. It lists for $3,495. The other features a 5 Mg. hard disk,the TS802H,it lists for $6,995. CALL FOR OUR PRICES.

They also offer aTS808 (8 user) and the TS816 (16 user) distributed process computers with Winchester hard disks. The TeleVideo TS801,a 64 K Z-80 machine with dual quad mini-floppies is only $3,995 list. All TeleVideo systems can be networked together using a high-speed serial port (RS422 at 800 kbs).
CALL FOR DETAILS AND PRICES

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MiniMicroMart also stocks Cromemco NorthStar,Hewlett Packard, and other leading computers ..... Please Call

SYSTEMS GROUP

Systems Group,a division of Measurement Systems Controls,long known for high quality memory boards has introduced a line of S100 computer systems. Their implementation of CP/M® is truelt unique. MP/M® and OASIS® operating systems are available. In addition to the system we have advertised,System Group offers units with built in Winchester hard disks.

The system comes with 64K of RAM and a DMA floppy disk controller board, as well as, two 8" disk drives. Serial and Parallel ports are provided.

Model 2812
(with dual double density,single-sided drives).
List $5,035, ... **$3,999**
Model 2814 with double density,double sided drives) List $5,890, ... **$4,699**



DYNABYTE
—DRASTIC PRICE REDUCTION!—

Dynabyte manufactures a full line of S-100 computer systems with a variety of mini-floppy and 8" disks. A full range of Winchester hard disks is also available. They have drasticlly reduced prices on a good deal of their product line and have also introduced a new compact computer,featuring a single quad density 5¼" floppy and a 5¼" Winchester hard disk in a single package. The units are available with 6, 10, or 16 Megabyte Winchesters.

Dynabyte provides CP/M® 2.2,MP/M® ,or OASIS operating systems as options. they also offer the Business Maneger,a fully integrated complete accounting package including inventorycontrol and order entry. It is user friendly and reasonably priced. Dynabyte also offers other application software.

MiniMicroMart stocks a reletively large portion of the Extensive and flexible Dynabyte line



NEW DYNABYTES

5505/81 (64K mini-floppy and 6Mg. miniwinnie)
List $6,995 ..... our price **$5,595**
5505/B1 (64K mini-floppy w/ 10Mg. miniwinnie
List $7,695, ... our price **$6,155**
5605/C1 (64K mini-floppy w/16Mg. miniwinnie
List $8,495, ... our price **$6,795**
5300/C1 (64K dual,single sided 8" drives)
List $4,995, ... our price **$3,995**
5300/B2 (64K dual,double sided 8" drives)
List $5,995 ..... our price **$4,795**
5200/A2 (64K dual,quad mini-floppy)
List $3,995 ..... our price **$3,195**

A full line of 8" Winchesters is also in stock.

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TeleVideo



925C

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910C,..... CALL
912C,..... CALL
920C..... CALL
925C..... CALL
950C,..... CALL

SOROC

IQ-120 List $995 **SPECIAL $695**



IQ 130,..... $595
IQ 135,..... $749
IQ 135G,..... $799
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TI CRT Terminals
940 Basic..... $1599
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1420 w/lower case and numeric pad.... CALL
1500,..... CALL
1510,..... CALL
1520..... CALL
Executive 80-Model 20..... CALL
Executive 80-Model 30..... CALL
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ZENITH data systems
Z19 Video Terminal

Green Phosphorus Screen



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OUR PRICE
$729

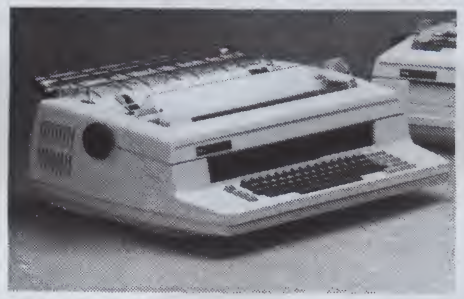
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730-3, (RS232C)..... *NEW LOW* $489
739-1 w/Graphics, Parallel,... *NEW LOW* $525
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352, 200 CPS..... CALL
353, 200 CPS..... CALL

DIABLO 630 (RS232C),55CPS,..... $2299

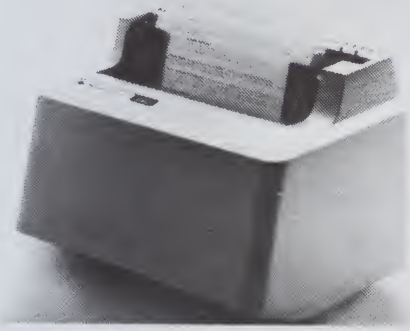
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3530 RO, Cent. Interface, 35 CPS,..... $1945
7710 RO, (RS232C),55 CPS,..... $2395
7720 KSR, (RS232C), 55 CPS..... $2999
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IDS-445..... $669
IDS-445G..... $749
IDS-560..... $1099
IDS-560G..... $1139
IDS Prism 80..... 9$998
IDS Prism 80 w/color..... $1349
IDS Prism 132..... $1349
IDS Prism 132 w/color..... $1695

Texas Instruments



TI 810 Basic..... $1349
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810 VCO/full..... $1595
820 RO w/lower case..... $1645
820 RO w/full ASCII,comp. print... $1795
745 Portable Terminal..... $1399
745 Portable Terminal w/U/L case... $1495

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80..... $389
82A..... $519
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84..... $1199
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- 3 Way Paper Handling System
- Paper Out Switch
- TOF (66 Lines or 72 Lines)
- Self-Test
- 96 Character ASCII
- Microprocessor Electronics
- Expanded Print
- Right Margin Justification
- Print Underlining
- 9 Wire Free Flight Printhead
- Bi-Direct. Paper Movement
- Full One Line Buffer
- 6 Lines/ in.Vertical Spacing

739-1 Dot Matrix Printer
(parallel)
List $695
CEN-27391-0 **..$525**



739-3 Dot Matrix Printer
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Dot Matrix Printer
List $860 CEN-27301-0
$399

730-3 Dot Matrix Printer
(RS232 Serial)
List $915 CEN-27303-0 **..$489**

STANDARD FEATURES

- 100 characters/second @ 10 CPI; 132 CPL @ 16.7 CPI
- 80 characters/line
- 30 lpm with 80 columns printed
- 75 lpm with 20 columns printed
- microprocessor electronics
- 7x7 dot matrix
- 10 characters/inch and 16.7 characters/inch
- 6 lpi vertical
- unidirectional print and return approximately 10 ips
- 3-way paper handling system
- 96 character ASCII
- 1 Line Buffer, Parallel 256 Char. Buffer, Serial

6081 Band Line Printer
List,$7120 CEN-28061-0 .. **$5695**

600 Lines Per Minute
(750 LPN with a 48 character set)

STANDARD FEATURES

- 132 CPL
- 15 IPS Slew Rate
- Microprocessor Electronics
- 10 CPI Horizontal Spacing
- 6/8 LPI Vertical Spacing
- Out of Paper Sensor
- Cassette Ribbon
- 12 Channel Direct Access VFU
- Auto Motor Control
- Operator Control Panel
- UL and CSA Approved
- 4" to 17" Forms Width
- Operator Changeable Font
- CDCC 8-BIT Parallel or Data Products Interface
- Floor Standing Cabinet
- Forms Density Control
- Test Print
- Paper Restacking
- 1 to 6 Part Forms Capability
- 3" to 17" Forms Length



350
Dot Matrix Printer ***Call For Price***

STANDARD FEATURES

- 200 CPS
- Bidirectional/Logic Seeking
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- Cut Sheet and Continuous Fanfold Forms Handling
- Demand Document Capability; Forms Tearoff Withing 1" of Last Printed Line
- Serial and Parallel Interface
- Pin Addressable Graphics
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- Operator Replaceable Snap-In Printhead
- Self-Diagnostics on Power-Up; Self-Test Feature
- Downline Loadable 96 Character Set
- Extensive User Selectable or Program Controlled Parameter Selection
- 3 Digit Liquid Crystal Display to Facilitate Parameter Selection
- Horizontal and Vertical Tabs
- Top and Bottom Margin
- Auto Line Feed
- 2 Channel Downstream Loadable VFU
- Nonvolatile Parameter Storage via Control Panel
- Subscript/Superscript
- 8 IPS Paper Slew
- 132 Column Print Width at 10 CPI
- 6 Part Forms Handling Capability
- Audible Alarm
- Column Scale and Tear Bar
- Centronics Colors and Logo
- Cover Interlock Switch

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CONFUSED ABOUT A SYSTEM CHOICE ?

We have always featured machines intended for business use, word processing, as well as for scientific and industrial applications. We have not been involved in machines where games, and game software were strong points.

In general, we stock and recommend systems that support a standard 24x80 display, addresses 64K of RAM, and is capable of running a CP/M compatible operating system.

APPLE II

The Apple II is without question an extremely popular machine in the personal computer marketplace; it helped make the industry what it is today. However the Apple II is a five year old design.

The Apple II uses a 6502 processor, and a special version of Microsoft Basic. Hundreds and hundreds of software packages exist for the Apple. Most are games but there are also many business oriented programs (the most notable of which is VisiCalc). However, few sophisticated business packages have been written for it because of the limited capabilities of the hardware (the limited disk storage, and the lack of a 24x80 display).

The Apple enthusiast will counter with the numerous 24x80 display conversions that exist, and the availability of various 8'' disk drives, as well as hard disks. This is all true. And with the addition of Microsoft's Softcard, and an additional 16K of RAM, the Apple will run a great variety (but not all) of the programs intended to run under a CP/M operating system.

If you already own an Apple, and have a lot of software developed for it, there are certainly ways to enhance it. However, the wise owner would consider the alternatives before investing good money after bad.

If you do not already own an Apple, visit your local dealer; have him quote you on a system with two disk drives, 64K of memory, a printer interface card and a 24x80 video board. Include the cost of a decent high resolution monitor, as a TV set won't suffice and the cheap monitors won't either.

Before you take out your checkbook, examine the total price, and give it a little thought. Will the Apple disks give you all the storage you need, for either word processing applications or for you other requirements? *Of course, you can always add a hard disk, but would you care to back up 10 megabytes 130K at a time?* Two Apple disks give you 260K, less then that of one drive on a SuperBrain, Horizon, Advantage or TeleVideo Systems computer.

Most important of all, does all the software you're ever going to use exist for the Apple II? Probably not, and if there is some CP/M software you may want to run you have to add the Microsoft Softcard, etc...

Calculate the price of an Apple II configured as a business system — you will find that it is no bargain.

APPLE III

There is no question that the Apple III is more of a business system than the Apple II. The Wall Street Journal called the Apple III a lemon. We think they were unfair, even though there were serious technical difficulties. The Apple III isn't much as a business machine either. It also has limited disk capacity, and very little software is available to run on it.

ATARI

Atari has an outstanding entry level machine, with better color graphics than Apple, and certainly a better value. Neither the Atari 400 or 800 are what we call business machines, but Corvus will supply a hard disk.

COMMODORE

Commodore , with an endless variety of machines and marketing plans has never been a serious contender in the business machine world; The Pet uses a 6502 processor, their own version of Microsoft Basic, and their own interfaces. They aren't compatible with anyone.

IBM

There is absolutely no question that the IBM personal computer is going to be one of the top sellers; it will give the Apple management fits as it will compete with both the Apple II and the Apple III. Even though it will be an outstanding success, it is still more of a home computer than a business machine. Had anyone other than IBM introduced it, it would have received very few press notices, and would have been a failure.

IBM chose a 16 bit chip, totally unnecessary for the task at hand, except for enhanced graphics, and interfaced it to an 8 bit bus. Their is *very little software for it, and extensive new software* will be a longtime in coming.

For word processing and business applications the 16 bit processor hasn't done anything for the user in the long run; it has merely created a scramble to develop software.

In spite of these comments the IBM machine will be extremely popular and someday we hope to sell it.

Z-80's AND S-100 SYSTEMS

The early emergence of CP/M as a defacto standard operating system for 8080/Z80 based microprocessor systems was perhaps the most single significant factor in fostering the rapid growth of the personal computer industry. It enhanced the popularity of 8080/Z80 based systems. It fostered the developement of high caliber software, since one could write it simultaneously for a multitude of different systems. Software written for an IMSAI also ran on a Cromemco, NorthStar, Vector Graphic, Dynabyte, Industrial Micro Systems, ALTOS, or SuperBrain computer (the vendor list is endless and it included many home brew systems).

Most systems that run CP/M, also run Digital Research's MP/M, a multi-user system. OASIS, an operating system with most of the features found on large systems, runs on most of the systems named above, in both single user and multi-user versions. Cromemco has CDOS which is virtually CP/M compatible, and also has perhaps the best multi-user system, Cromix, which is a UNIX look alike. Cromix runs most CDOS and CP/M programs.

NorthStar has TSS/C, which runs NorthStar Basic as well as CP/M, in a multi-user environment; there is IO/S and multi-user IO/S (which are CP/M compatible) and Morrow has introduced Micronix, another UNIX look alike which runs CP/M as a task. There is also TP/M.

This compatibility of CP/M software and the S-100 hardware propelled 8080/Z80 based microprocessor systems into serious contention with 16 bit minicomputers, and assured their dominance in commercial and industrial applications over the 6502 based Apples and Pets, as well as the struggling 6800 contenders.

One can purchase an S-100 system, without fear of obsolescence, since the boards are for the most part interchangeable.

16 BITS

Three or four years ago I remember a customer who postponed buying a system because 16 bit systems were just around the corner. The same 16 bit systems are still just around the corner; the chips have existed for years, but millions of man hours of software are still lagging behind. Perhaps by late 1982 or in the early half of 1983, enough software will be available for the 8088's, the Z8000's, and the 68000's so they will be able to compete in practical usefulness with the average Z80 based machine.

MiniMicroMart will be selling the leaders in the 16 bit field. Cromemco has introduced a 68000 S-100 based machine which will run a Cromix operating system. Don't get confused — this doesn't mean that practically anything that runs in Cromemco's current Cromix is going to run on the 68000 machine;

If one is going 16 bit, it would seem that currently the 68000 is the way to go; in reality it is a 32 bit microprocessor that multiplexes data onto a 16 bit bus.

8086/8088's, Z8000's and 68000's are high performance processors; to take full advantage of them it will require more complex systems and additional memory. They will benefit only those who rely on these systems for extensive number crunching, and in heavily used large multi-user systems. I doubt that they will have much benefit for the individual user to running his payroll, his general ledger, or his word processing.

DISTRIBUTED PROCESSING

Distributed processing is the best of many worlds. It is possible to put eight or more users on a single Z80, but if there are eight simultaneous users, particularly in operations that are processor intensive, it would tend to slow it down. *There is no reason to share a Z80.*

A number of systems now provide a complete Z80 system for every user, and permit sharing a single data base on a common hard disk. Among the first was, the Intertec CompuStar system. TeleVideo has introduced a variety of systems that operate in a similar fashion.

The Discovery System from ACTION, and other vendors provide similar, even more sophisticated S-100 systems. Some of these systems are running the new Turbodos operating system.

These systems have one thing in common — every user has his own Z80, his own 64K of RAM, and his own I/O ports; the executive operating system has its own Z80 and its own 64K of RAM and manages the common hard disk.

Obviously the S-100 systems accomplish this with numerous single board computers plugged into one bus; TeleVideo and Intertec accomplish essentially the same thing by communicating to the master system over special data cables. There are pros and cons to both. TeleVideo and Intertec provide for every user being totally independent, as every user can have two minifloppies as part of his terminal/computer station.

A business system should have 64K of RAM, and two disks with a minimum capacity of 250K each. A CP/M type of operating system is a MUST. THE ACTUAL BRAND OF THE SYSTEM ISN'T THAT IMPORTANT.

ONE MILLION DOLLAR INVENTORY CLEARANCE SALE

On the adjoining page is an order form. Use it!

Even if it is only to get on our permanent mailing list — send it in with or without an order.

Until April 30, 1982 we are giving an extra 5% off on over one million dollars worth of our already discounted offerings.

Most, but not all items are included. If you are thinking of buying a system, this is the ideal time; if you already have a system, this is the time to add peripherals or upgrade it.

Even if you can't make the purchase now, get on the mailing list to hear about future specials.

Why are we reducing prices?

Late in 1981 MiniMicroMart moved to new larger quarters and finally got all of its inventory under one roof; we were able to organize our stock.

Our auditor started using our inhouse computers to advantage, and suggested drastically reducing inventory levels on some items and increasing the inventory on others. In the end, we will actually be increasing our total inventory, as many new lines will be added.

Enclosed with this Mini Catalog is a printout of some of some of the inventory items that our auditor considered excess stock. 5% was deducted from normally discounted prices. The report shows our excess inventory level, on the date it was printed.

These prices were calculated using our internal price list. In spite of diligent efforts to correct it, it does contain errors. It is our intention to offer you 5% off of our regular prices. So we absolutely reserve the right to correct them. We plan to go back to normal pricing on May 1, 1982, or when the excess stock of any item is depleted.

The price list enclosed is not complete; if you don't see what you want, call or write. *The extra 5% will also be applied to selected items which may not be in inventory, to help us meet purchase commitments, etc...*

However, on items not on the list, it will be our option to apply the additional discount. *Obviously you can expect immediate delivery on these sale items.* In the event that we run out of stock while your order is in transit, we reserve the right to cancel your order, and send you a full refund. In most cases we will attempt to honor the sale price, if you are willing to wait for us to get delivery.

New products and price reductions

We have been able to significantly reduce the price of most 64K RAM boards (our extra 5% will also apply) including Cromemco, NorthStar, Systems Group (MSC), Memory Merchant, and California Computer Systems.

Just take a look at our new prices on the HP-85 and the new HP-125, and many HP accessory items. Dynabyte has also reduced prices and there has also been a substantial price reduction on the NorthStar Horizon.

The new HP-87 with CP/M

Hewlett-Packard has introduced a new compact desktop computer, replacing the HP-83 which will combine the best of both worlds; it offers your choice of HP's proprietory Series 80 microprocessor and software or you can plug in an accessory CP/M board (a la Apple); the desktop unit has a built-in 24x80 display, and provides for virtually unlimited memory. It comes with 32K of RAM at $2495 list (our price will be $1995). The Z-80 CP/M card, including 64K of RAM will list for $495, our price $399. You will have to add an HP disk drive (see our new low prices).

Without question this machine will be serious competition for the Apple II, the Apple III, and IBM personal computers. It is a serious professional computer (no one outdoes HP in quality); VisiCalc is available, as well as WordStar (in CP/M); other software for business and professional applications are being made available in HP Basic.

You can install and address over 500K of RAM, if necessary, (some VisiCalc users will love it), and their VisiCalc runs their plotters directly (including the new one, which will list for around $1500).

New Mini Winchesters

Last year dozens of manufacturers introduced 5¼" mini-winnies; now they are starting to deliver and some are increasing the capacity. Most of our vendors are starting to deliver systems and subsystems employing these units. They are priced so that every serious computer user can afford them.

Cromemco has introduced a 5 megabyte for under $3500 list and NorthStar has one at under $3000 list; these units are specifically for these machines. Morrow has introduced their Discus M5, with a new DMA controller, which will run on most S-100 systems for under $2500 list, and Konan has introduced the David subsystems which will run on the Apple, the Xerox, the TRS-80, S-100, and perhaps soon on machines such as the IBM and the SuperBrain. The Konan David lists $2995 for the Apple, and is slightly more for other machines and for capacities over 5 megabytes.

Corvus has reduced prices on their product line (5, 10 and 20 megabyte) and has made them available for virtually every microprocessor system. Intertec has reduced the price of the 10 megabyte drive for the SuperBrain and CompuStar to $3995.

And in most cases the MiniMicroMart extra 5% will apply.

The Cromemco 68000 System

Cromemco has announced their long awaited 68000 computer, using a Cromix operating system. (The 68000 *is* a true 32 bit CPU, multiplexed on a 16 bit bus). Their CPU board will also have a Z-80A processor. The software will automatically choose the Z-80 or the 68000 Cromix operating system and then turn on the corresponding CPU chip. It will prepare you for the future while enjoying the opportunity to use available Z-80 software.

The battle lines are clear; the 68000 will be the winner amongst the contenders for dominance in the 16 and 32 bit microprocessor field. It will be the choice by those needing a more powerful processor for extensive number crunching and heavy multi-user use.

The Cromemco 68000/Z-80 CPU board lists for $995; a memory management board, as well as 256K and 512K RAM boards will complete the line.

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NOTES AND SPECIAL INSTRUCTIONS

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I regularly read:

B ☐ Byte
C ☐ Creative Computing
M ☐ 80 Microcomputing
L ☐ Electronic News
D ☐ Radio Electronics
W ☐ Computer World
K ☐ Kilobaud/Microcomp.
I ☐ Interface Age
F ☐ Infoworld
U ☐ Popular Electronics
E ☐ Computer Design
X ☐ Personal Computing

OTHER _____

(X) I own (put an X in the box if you own one
(O) Interested (circle if considering purchase)

A ☐ Apple
T ☐ TRS-80 Mod. I/III
S ☐ Superbrain
Z ☐ Zenith Z-89
C ☐ Cromemco
O ☐ Other 8080/Z80
P ☐ Pet
R ☐ TRS-80 Mod. II
H ☐ HP-85
N ☐ NorthStar
W ☐ Other S-100

CP/M SYSTEMS

Some years back MINIMICROMART made the wise choice to sell only systems that supported a CP/M operating system. Since then Z-80 CP/M conversion boards have been introduced for the very popular APPLE II (SEE THE SPECIAL ON THIS PAGE) APPLE is touting the fact that soon a CP/M upgrade will be available for the APPLE III; we understand that a Z-80 CP/M board is being introduced for the new IBM PERSONAL COMPUTER.

HEWLETT PACKARD introduced a machine called "the personal office computer" (the HP-125) and it was CP/M based; they have just introduced the new HP-87, with one of the principal features being an accessory Z-80 board running CP/M. DEC, the world's largest manufacturer of minicomputers has introduced a kit to upgrade their VT-100 terminal to a Z-80 based CP/M compatible computer. XEROX has introduced their 820, which is also CP/M based. It is significant that many TRS-80 I and III users are running a modified CP/M and that most TRS-80 model II users are probably running CP/M. The Ohio Scientific machines, which started out primarily as a 6502 based product, now finds most of its users, using it as a Z-80 CP/M machine.

NEED WE SAY MORE. Follow the tidal wave, buy a CP/M based machine. We sell the leading ones, and you can't go very far wrong buying any of the lines we sell. We would be pleased in helping you select a system from CROMEMCO, NORTH STAR, DYNABYTE, MORROW, SYSTEMS GROUP, INTERTEC, INTERSYSTEMS, TELEVIDEO SYSTEMS, CALIFORNIA COMPUTER SYSTEMS, HEWLETT-PACKARD, ZENITH and others.

If you would prefer an APPLE or an ATARI or a NEC PC-8000, we can get you one. However you get what you pay for, and if you analyze all of the machines you will find that there isn't much difference in price between any of them configured to do the same thing, and offering the equivalent amount of disk storage.

TRS-80 OWNERS

IF YOU OWN A TRS-80, BE SURE TO LET US KNOW

We will put you on a special mailing list (advise if you have a model I, II, or III.)

We will advise you of special offerings. Currently we are offering the CENTRONICS 730, at only $399. Until April 30th, you can take an extra 5% discount, on this printer which is identical to the RADIO SHACK LINE PRINTER II. We are also offering 40 track disk drives, with cabinet and power supply, suitable for the TRS-80 MODEL I for only $279.

At a special price we have some LOBO expansion interfaces; they permit using both large and small drives, single and double density. Call us.

APPLE OWNER

Be sure to get on our special Apple mailing list, if you own an Apple (or are planning on buying one).

Right now, we are offering an exceptional value on an upgrade to CP/M® for your APPLE II. You can have the MICROSOFT SOFTCARD (a board with a Z-80, with MICROSOFT BASIC and CP/M® included), MICROSOFT'S BUFFERED 16K RAM BOARD, the VIDEX VIDEOTERM 80 column board, with a soft video switch and inverse video, all for only $639. This has a retail value of over $1,000.

Until April 30, 1982, you can buy a NOVATION APPLE CAT II modem from us for $312.55, and we will also include your choice of an APPLE CAT II handset (value $29) or an APPLE CAT II BSR remote controlled transformer (value $19) free.

MINIMICROMART also stocks and is currently offering at special prices APPLE boards from SSM, MOUNTAIN COMPUTER, and CALIFORNIA COMPUTER SYSTEMS. In addition, we have excellent prices on VISICALC, etc. from PERSONAL SOFTWARE.

SERVICE

Prospective purchasers of computers, particularly business systems are always concerned about service. Of course all the systems come with a limited manufacturer's warranty, usually 90 days. The beauty of S-100 systems is we can very often trouble shoot them on the phone and determine which board is defective. Some of our customers stock their own spare boards, if they are extremely concerned about downtime.

Many of the manufacturers have now made arrangements for third party on site service in all the major cities. CROMEMCO has made the arrangement with TRW and NORTH STAR has a contract with SORBUS. TELEVIDEO SYSTEMS works through GENERAL ELECTRIC APPARATUS SERVICE, and INTERTEC through CARTERFONE. ZENITH also has provided for on site service through independent dealers and service centers. Perhaps the best and most extensive on site service is available through HEWLETT-PACKARD for their HP-125; if you are willing to pay for it, they will even provide you with on site training.

CENTRONICS offers on site service on their commercial printers and TEXAS INSTRUMENTS has an extensive service organization for their machines. EPSON has made arrangements for you to bring your printer to certain RCA service centers.

PRICING POLICY

ALL MINIMICROMART ADVERTISED PRICES, UNLESS OTHERWISE SPECIFIED, ASSUMES THAT THE ORDER WILL BE FULLY PREPAID PRIOR TO SHIPMENT. This advertised prices includes our prepayment 2% "cash discount." If you prefer a C.O.D. or wish to use a VISA or MASTER CHARGE card, please add 2% to our advertised prices (some of our price lists show a "discount" price as well as a "cash" price — the discount price includes the additional 2%).

SHIPPING & C.O.D.

Our normal method of shipping is UNITED PARCEL SERVICE; please include estimated shipping fee. Any overpayment in excess of $1 will be refunded. Our minimum charge for shipping, handling and insurance is $3.00. Large cartons and any single carton with a weight in excess of 50 lbs. has to be shipped by truck or air freight. Freight charges, by air or truck, are normally shipped freight charges collect. Please note: C.O.D. fees charged by air and truck lines (especially truck) are at the discretion of the carrier and can be extremely expensive. We have seen truck C.O.D. fees that have been 4% of the C.O.D. amount. (There is no extra fee for the actual freight charges collect.) We strongly suggest that you prepay all purchases which are to be shipped by air or truck.

Unless arrangements are made otherwise, all C.O.D.s in excess of $100 will require cash or bank cashier's check. (In fact, if we fail to notify a truck or air carrier otherwise, their normal practice is to require cash or bank checks.)

BANK WIRES

Many of our customers have found using the electronic communications network of the Federal Reserve system a convenient way to arrange for prepayments. Bank wires are reasonably inexpensive and take but a few hours; they are available from nearly all banks, and if you know your banker he will do it for you on the strength of a telephone call. If you care to wire us funds, our bank is the MARINE MIDLAND BANK, SYRACUSE, NY, ACCOUNT #210-72564-8. Tell your banker that we need to be "phone advised."

PURCHASE ORDERS

We do accept purchase orders from government institutions, schools, and large corporations such as those listed on the New York or American stock exchanges, and that have exceptionally high Dun and Bradstreet ratings. We regret that we cannot accept purchase orders from smaller firms. Exceptions will be made to rated firms who have purchased from us in excess of one year and whose average purchases exceed $2500/month.

As previously stated, our advertised prices are for orders that are prepaid, obviously pricing on orders that incur the expense of billing and for which payment will be delayed for an extended period are billed at a higher price. We do allow a prompt payment discount, the new effect of which reduces the purchase order price to almost the cash price.

PRICE CHANGES

Prices in this industry change constantly. We reserve the right to alter prices without notification for any reason, especially to correct unavoidable errors. We also reserve the right to withdraw any offer without notice. We usually bend this policy to the benefit of the customer.

CLAIMS AND RETURNS

Inspect all shipments immediately upon receipt. Missing cartons or obvious damage should be noted on the respective delivery receipt when it is signed. In the case of concealed damage notify the respective carrier at once, and request an inspection. Claims for shortage or damages must be made within one week after receipt of shipment. Claims for lost shipments must be made within two weeks of receipt of invoice or other notification of actual shipment. Damaged cartons must be saved until the claim is settled.

MINIMICROMART will not accept any merchandise for return or exchange without a return authorization number (RMA #). If you receive equipment which is malfunctioning, or apparently malfunctioning, contact our customer service department. We will advise you as to whether the unit is to be returned to us or to the manufacturer, or whether on site service is available.

MINIMICROMART assumes that the purchaser has made a proper selection and does not assume any responsibility for a customer choosing the wrong system, accessory, or software. All sales are final; software vendors normally do not allow us to accept software for credit or exchange.

The right to return merchandise for exchange or credit is totally at the discretion of MINIMICROMART, INC.; in any case, unless there has been an error by MINIMICROMART, INC., the customer will pay freight charges in both directions and there will be a restocking charge. The minimum restocking charge is $20 or 20%, whichever is larger.

If a customer receives defective merchandise it will be the policy of MINIMICROMART, INC. to pay for the cost of returning the repaired or exchanged unit to the customer. Normally the customer will pay for the cost of returining the defective unit to MINIMICROMART or other designated repair facility.

WARRANTY

Since the Seller, Mini Micro Mart, Inc. does not control the use of its products, there are no express warranties which extend beyond the description of the face hereof. Seller disclaims any implied warranties of merchantability or of fitness for any particular purpose. Since Seller cannot control the manner or use of its products after their sale. Seller shall not be responsible for any consequential or indirect damages. Since Seller is only acting as a distributor of products manufactured by other companies. Seller expressly limits its liabilities to any guarantees extended by the manufacturer, *which guarantees* seller will pass through to the customer. Seller will at its option, either replace the goods sold or refund the purchase price.

THIS MINIMICROMART PRICE LIST REFLECTS OUR EXTRA 5% REDUCTION

MARCH 12, 1982

MFG-PRODUCT CODE	STOCK #	DESCRIPTION	SPECIAL PRICE
ADK AMDEK / LEEDEX			
ADK-APPLE II	ADK-39000-A	APPLE HIGH RES COLOR ADP	160.55
ADK-VIDEO 100	ADK-60100-0	LOW COST 12IN VIDEO MONITOR	132.05
ADK-VIDEO 100G	ADK-60100-G	12IN VIDEO MONITOR-GREEN PHOS	141.55
ADK-VIDEO 300	ADK-60300-G	12 IN GREEN MONITOR H. RES	189.05
ADK-COLORI	ADK-62000-0	13IN COLOR MONITOR	341.05
ADK-COLOR II	ADK-62002-0	13 IN COLOR MONITOR H RES	759.05
CCS CALIFORNIA COMPUTER SYSTEMS			
CCS-2002A	CCS-10253-4	34 PIN CABLE	25.65
CCS-2200-01/02	CCS-12200-1	12 SLOT MNFRM-+8V@8A,+/-16@4	341.05
CCS-2210-01	CCS-12210-A	BASIC SYS-S100 COMPUTER A&T	1,705.25
CCS-2810-01	CCS-31000-A	Z-80 CPU BOARD-ASM	255.55
CCS-2016BA	CCS-32016-1	450NS 16K STATIC RAM BD-ASM	204.25
CCS-2016BC	CCS-32016-3	200NS 16K STATIC RAM-ASM	246.05
CCS-2116A	CCS-32016-A	16K STATIC RAM-450 NS	204.25
CCS-2116B	CCS-32016-B	16K STATIC RAM-300 NS	166.25
CCS-2116-03	CCS-32016-C	16K STATIC S-100 BD-200NS	246.05
CCS-2032-03	CCS-32032-2	32K STATIC RAM BD-200NS	569.05
CCS-2032B	CCS-32032-3	32K STATIC RAM BD-300NS	574.75
CCS-2032A	CCS-32032-4	32K STATIC RAM BD-450NS-ASM	508.25
CCS-2065-03	CCS-32064-2	64K DYNAMIC RAM BD-200NS ASM	474.05
CCS-2422-01	CCS-33200-8	DD FLOPPY DSK CTRL W/CP/M	322.05
CCS-2710-01	CCS-34000-A	4 PORT S/IO S-100 BD	236.55
CCS-2720-1	CCS-34010-A	S-100 4 PORT P/IO BOARD	189.05
CCS-2500-01	CCS-39010-A	PT-1 S-100 WIREWRAP PROTO BD	37.05
CCS-2510-01	CCS-39020-A	PT-2 S-100 SOLDERTAIL PROTO BD	27.55
CCS-2520AK	CCS-39051-K	S-100 EXTENDER TERMINATOR KIT	36.10
CCS-7424A	CCS-39424-A	APPLE CALENDAR CLK	94.05
CCS-7712A	CCS-39712-A	APPLE SYNCH DER INTERFACE	141.55
CCS-7728-01	CCS-39728-A	APPLE CENTRONICS PRINTER INT	94.05
CCS-7470-01	CCS-39747-A	APPLE BCD A/D CONVERTER	94.05
CCS-7710-01	CCS-39771-A	APPLE ASYNCH RONOUS INTERFC	132.05
CCS-7720-02	CCS-39772-B	APPLE PARALL W/CEN ROM & CBL	113.05
CCS-T2400AA	CCS-52400-A	HUH MINI 8100S-ASM	93.10
CCS-T5400AA	CCS-55400-A	HUH-MINI 8100-ASM	114.00
CCS-7340A	CCS-57340-A	CABLE-7728 TO IDS-440	27.55
CCS-7379A	CCS-57379-A	CABLE-MODEL 7728A/CEN PRTR	27.55
CEN CENTRONICS			
CEN-704-11	CEN-27041-1	150 CPS DOT MATRIX-CENT INFCE	1,610.25
CEN-704-9	CEN-27049-0	RS232 9 X 9 DOT MATRIX PRINTER	1,515.25
CEN-730-1	CEN-27301-0	50 CPS DOT MATRIX PRINTER-PAR	379.05
CEN-730-3	CEN-27303-0	100 CPS DOT MATRIX PRTR-SERIAL	464.55
CEN-737-3	CEN-27373-0	PROP SPACING SERIAL PRINTER	664.05
CEN-737-4	CEN-27374-0	80 CPS SERIAL PRINTER-220V	664.05
CEN-739-1	CEN-27391-0	DOT MATRIX HI-DENS W/GRAPHICS	498.75
CEN-739-3B	CEN-27393-B	HI-DENS DOT MATRIX-RS232	607.05
CEN-739-4B	CEN-27394-B	HI DEN DOTMATRIX RS232-220V	654.55
CIT-8510	CIT-28510-0	DOT MATRIX PAR/SER PRINTER	569.05

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MFG-PRODUCT CODE	STOCK #	DESCRIPTION	SPECIAL PRICE
COM-912-P	COM-29120-P	9X12 DOT MATRIX 225 CPS,80 COL	413.25
CRO CROMEMCO			
CRO-Z2-X	CRO-10010-A	Z-80 MICROCOMPUTER ASM W/O ZPU	802.75
CRO-Z2H	CRO-10030-A	Z-80 HARD DISK ASM SYSTEM	8,070.25
CRO-Z2-FAN	CRO-10100-1	Z-2 52 CFM COOLING FAN	19.95
CRO-Z2D-FDD	CRO-10501-1	ADDL 5' DISK DRV FOR Z2D	474.05
CRO-Z2D-FDD-T	CRO-10501-2	ADDL 5IN DBL SIDEDDRV FOR Z2	474.05
CRO-WFD	CRO-10600-1	5' WANGCO DISK DRV/STA AL CS	398.05
CRO-HD5	CRO-10905-1	5 MEG ADD ON WINCHESTER	2,801.55
CRO-HDD-11	CRO-10911-1	11-MEGABYTE DISK MEMORY SYS	5,647.75
CRO-CS-3	CRO-11000-A	SYSTEM 3 WITH 64K RAM	6,455.25
CRO-BRZ-3	CRO-11900-1	AIR FLOW UNIT-CS3	559.55
CRO-CS-2	CRO-12000-A	Z-80 SYSTEM 2 WITH 64K RAM	3,371.55
CRO-CS-0	CRO-13000-0	CS-0 COMP SYS W/SCC+MCB-216	1,044.05
CRO-SYSTEM ZERO/D	CRO-13000-1	Z80 COMPUTER W/64K & DSK CONTR	2,417.75
CRO-CS-1	CRO-14000-A	Z-80 COMPUTER, 64K RAM, 8 SLOT	3,181.55
CRO-CS1-H	CRO-14000-H	Z-80 COMPUTER W/5MEG HARD DISK	5,600.25
CRO-3355A	CRO-23000-0	55 CPS LETTER-QUALITY PRINTER	2,820.55
CRO-3102	CRO-26000-0	CRT TERMINAL	1,851.55
CRO-CC-8	CRO-30010-1	8 SLOT CD CAGE INCL MOTHER BD	156.75
CRO-CC-12	CRO-30012-A	12 SLOT CD CAGE INCL MOTHER BD	198.55
CRO-PS-8/60	CRO-30100-0	110V POWER SUPPLY-CARD CAGE	280.25
CRO-PS-8/50	CRO-30100-1	220V POWER SUPPLY-CARD CAGE	280.25
CRO-SCC	CRO-31010-A	Z-80 SINGLE CARD COMP ASM	398.05
CRO-16KTP	CRO-32016-0	TWO PORT 16K DYNAMIC MEMORY BD	641.25
CRO-48KTP	CRO-32048-0	TWO PORT 48K MEMORY BOARD	1,205.55
CRO-16FDC	CRO-33200-0	DISK CONTLR CARD NEW DD	474.05
CRO-TRT	CRO-34010-A	TUART DIGITAL INTERFACE ASM	274.55
CRO-4PIO	CRO-34030-A	ELEC ISO 4-PT PARAL I/O INTFC	318.25
CRO-IOP	CRO-34050-0	INTELLIGENT I/O PROCESSOR	559.55
CRO-8PIO	CRO-34050-A	8 PORT PARAL INTERFACE ASM	236.55
CRO-PRI	CRO-34070-A	PRNTR INTERFACE CD ASM ONLY	198.55
CRO-8KBS	CRO-35010-A	8K BYTESAVER II PROM PROG ASM	236.55
CRO-16KPR-K	CRO-35051-K	16K PROM MEMORY CARD	198.55
CRO-32KBS	CRO-35070-A	32K BYTESAV ASM/INTEL 2716'S	280.25
CRO-D+7A	CRO-36030-A	DIGITAL/ANALOG INTERFACE ASM	236.55
CRO-CGI	CRO-37030-A	TV DAZZLER ASM	318.25
CRO-SDI	CRO-37100-A	HIGH RES COLOR GRAPHICS	641.25
CRO-EXC-2	CRO-39010-A	S-100 EXTENDER BOARD ASM	36.10
CRO-WWB-2	CRO-39050-A	S-100 WIRE WRAP BOARD ASM	36.10
CRO-JS-1	CRO-39070-A	JOYSTICK CONSOLE ASM	118.75
CRO-CBL-0	CRO-50100-0	PRIORITY INTERRUPT CHAIN CABLE	21.85
CRO-CBL-2	CRO-50110-0	TUART CABLE 62CM 24'	21.85
CRO-CBL-3	CRO-50130-0	TUART CABLE 110CM 43'	21.85
CRO-74903-1	CRO-54100-1	ROM-FOR SCC WHEN USED W/4FDC	14.25
CRO-ZM-108	CRO-55000-1	Z-80 MONITOR	21.85
CRO-CB-308	CRO-55010-1	3K CONTROL BASIC INTERPRETER	61.75
CRO-FDA-S	CRO-8000-S1	MACRO ASMBLR-SM DISKETTE	236.55
CRO-FDB-L	CRO-8010-L1	16K EXTENDED BASIC-LG DISK	156.75
CRO-FDB-S	CRO-8010-S1	16K EXTENDED BASIC-SM DISK	156.75
CRO-FDC-L	CRO-8020-L1	COBOL COMPILER-LG DISKETTE	474.05
CRO-FDC-S	CRO-8020-S1	COBOL COMPILER-SM DISKETTE	474.05

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MFG-PRODUCT CODE	STOCK #	DESCRIPTION	SPECIAL PRICE
CRO-FDF-L	CRO-8030-L1	FORTRAN IV COMPILER-LG DISK	236.55
CRO-FDF-S	CRO-8030-S1	FORTRAN IV COMPILER-SM DISK	236.55
CRO-FDR-L	CRO-8040-L1	RATFOR INCL FORTRAN IV	318.25
CRO-FDR-S	CRO-8040-S1	RATFOR INCL FORTRAN IV	318.25
CRO-STB-L	CRO-8050-L1	32K STRUCTURED BASIC-8' DISK	236.55
CRO-STB-S	CRO-8050-S1	32K STRUCTURED BASIC-5' DISK	236.55
CRO-LSP-L	CRO-8070-L1	LIST PROCESSING LANG(LISP)-8IN	318.25
CRO-LSP-S1	CRO-8070-S1	LIST PROCESSING LANG(LISP)-5IN	318.25
CRO-FDG-L	CRO-8100-L1	DAZZLER GAMES-LG DISKETTE	80.75
CRO-FDG-S	CRO-8100-S1	DAZZLER GAMES-SM DISKETTE	80.75
CRO-CDS-L	CRO-8110-L1	SYSEM DIAGNOSTIC SOFTWARE	160.55
CRO-CDS-S	CRO-8110-S1	SYSTEM DIAGNOSTIC SOFTWARE	160.55
CRO-RBTE-L	CRO-8130-L1	IBM 2780 REMOTE TERM EMULATOR	474.05
CRO-FDM-S	CRO-8300-S1	MULTI-USER/BASIC-SM	645.05
CRO-CROMIX-L	CRO-8380-L1	CROMIX MULTI USER OPRTG SYS	265.05
CRO-CROMIX-S	CRO-8380-S1	CROMIX MULTI USER OPRTG SYS	265.05
CRO-CCC-L	CRO-8390-L1	C SYSTEMS LANGUAGE/CROMIX	479.75
CRO-DGR-L	CRO-8410-L1	DAZZLER GRAPHICS PKG-LG	80.75
CRO-DGR-S	CRO-8410-S1	DAZZLER GRAPHICS PKG-SM	80.75
CRO-SGS-L	CRO-8420-L1	SUPER DAZZLER GRAPHICS(SDI BD)	474.05
CRO-SGS-S	CRO-8420-S1	SUPER DAZZLER GRAPHICS(SDI BD)	474.05
CRO-DBR-S	CRO-8501-S1	DATA BASE REPORTER-5 IN DSIK	80.75
CRO-DBM-L	CRO-8502-L1	DATA BASE MANGMT W/REPORT	318.25
CRO-DBM-S	CRO-8502-S1	DATA BASE MANGMT W/REPORT	318.25
CRO-WPS-L	CRO-8580-L1	WORD PROC SYS-LG DISK	236.55
CRO-WPS-S	CRO-8580-S1	WORD PROC SYS-SM DISK	236.55
CRO-GL-L	CRO-8600-L1	GENERAL LEDGER SYSTEM-FOR CDOS	711.55
CRO-TSS-L	CRO-8700-L1	TRACE SYS SIMULATOR-LG	156.75
CRO-TSS-S	CRO-8700-S1	TRACE SYS SIMULATOR-SM	156.75
CRO-WRMR-L1	CRO-8800-L1	WRITEMASTER WORD PROC SYSTEM	474.05
CRO-WRMR-S1	CRO-8800-S1	WRITEMASTER WORD PROC SYSTEM	474.05
CRO-SPMR-S	CRO-8801-S1	SPELL MASTER PROOF-READ PROG	236.55
CRO-SLMR-L	CRO-8810-L1	SLIDEMASTER-8 INCH	474.05
CRO-SLMR-S	CRO-8810-S1	SLIDEMASTER-5.25 INCH	474.05
DIA DIABLO			
DIA-630	DIA-20630-0	RS232 DAISY WHEEL PRINTER	2,184.05
DIA-TRACTOR FEED	DIA-29100-0	TRACTOR FEED ATTACHMENT	299.25
DYN-5200/A2	DYN-15200-A	64K Z 80 COMP DUAL 5.25 DRV	3,035.25
GBT GODBOUT			
GBT-DESK ENCLOSURE2	GBT-11000-0	S-100/696 MAINFRM & PWR SUPPLY	664.05
GBT-CPU 8085/88-A	GBT-31010-A	CPU BD-8085/88-ASM	341.05
GBT-RAM XX-24 ASM	GBT-32026-A	24K STATIC RAM BD-ASM	436.05
GBT-RAM XX-24 UNK	GBT-32027-K	24K STATIC RAM BD-UNKIT	346.75
GBT-RAM XX-32 ASM	GBT-32032-A	32K STATIC RAM BD-ASM	565.25
GBT-RAM XX-32-UNK	GBT-32033-K	32K STATIC RAM BD-UNKIT	451.25
GBT-RAM 16-64-A&T	GBT-32064-A	S-100 STATIC RAM-64KX8/32K-16	721.05
GBT-DISK 1-ASM	GBT-33200-A	DMA DBL DENS DSK CONTROLLER	398.05
GBT-DISK CABLE	GBT-33201-1	DISK CABLE-DISK 1 TO DRV ENCL	20.90

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MFG-PRODUCT CODE	STOCK #	DESCRIPTION	SPECIAL PRICE
GBT-INTERFACER I-A	GBT-34000-A	2 RS232 SERIAL PORTS-ASM	198.55
GBT-INTERFACER II-A	GBT-34002-A	1 SIO, 3 PIO I/O BD-ASM	198.55
GBT-INTERFACER II-K	GBT-34003-K	1 SIO, 3 PIO I/O BD-UNK	160.55
GBT-INTERFACER 3-8	GBT-34038-A	8 MULTI-USER SIO, 2 BI-SYNC	565.25
GBT-INTERFACER CBL	GBT-34100-2	INTERFACER CABLE	17.10
GBT-INT 3 CUST CBL	GBT-34100-3	INTERFACER 3 CUSTOM CABLE	28.50
GBT-SPECTRUM-UNK	GBT-37101-K	COLOR GRAPHICS W/RAM, PIO	241.30
GBT-CP/M-80 2.X-I2	GBT-8020-I2	CP/M FOR 8080/280-8 INCH	142.50
GBT-CP/M-86-I2	GBT-8086-I2	CP/M FOR 8086/88CPU-8IN	237.50
HAZ HAZELTINE			
HAZ-H-1410	HAZ-24010-1	ECONOMY TERM W/NUMERIC PAD	711.55
HAZ-H-1500	HAZ-25000-A	VIDEO TERMINAL	835.05
HAZ-H-1510	HAZ-25010-1	VIDEO TERM W/FUNCTION KEYS	1,034.55
HAZ-H-1520	HAZ-25020-1	VIDEO TERM W/PRINTER INTERFACE	1,319.55
HEW HEWLETT PACKARD COMPUTERS			
HEW-HP125	HEW-10012-5	64K COMPUTER SYSTEM	2,079.55
HEW-HP125 OPT 80	HEW-10012-8	64K Z-80 COMPUTER W/8IN OS	3,020.05
HEW-83A	HEW-10083-0	PERSONAL COMPUTER W/O PRTR,CAS	1,325.25
HEW-HP85A	HEW-10085-0	SELF-CONTAINED COMPUTER	2,085.25
HEW-82901M	HEW-10100-2	5.25 DUAL MASTER FLEX DSK DRV	1,709.05
HEW-9895A	HEW-10108-2	8IN DL MASTER FLEX DSK DRV	4,701.55
HEW-00085-15001	HEW-10315-1	HP85 MASS STORAGE ROM	124.45
HEW-00085-15002	HEW-10315-2	HP85 PLOTTER/PRINTER ROM	124.45
HEW-00085-15003	HEW-10315-3	HP85 I/O ENHANCEMENT ROM	251.75
HEW-00085-15004	HEW-10315-4	HP-85 MATRIX ROM	123.50
HEW-82937A	HEW-10900-1	HP-IB INTERFACE MODULE	337.25
HEW-10833D	HEW-10930-1	1/2 METER HPIB CABLE	59.85
HEW-10833A	HEW-10930-2	1 METER HP-IB INTERCONNECT CBL	59.85
HEW-10833B	HEW-10930-3	2 METER HP-IB INTERCONNECT CBL	63.65
HEW-10833C	HEW-10930-4	4 METER HP-IB CABLE	73.15
HEW-82941A	HEW-10941-0	BCD INTERFACE-HP85	422.75
HEW-82939A	HEW-10950-0	SERIAL(EIA) INTERFACE-FM CONN	337.25
HEW-82939A OPT 001	HEW-10950-1	RS232 INTERFACE-MALE CONN	337.25
HEW-82939A OPT 002	HEW-10950-2	SERIAL INTERFACE/CURRENT LOOP	337.25
HEW-82936A	HEW-12936-1	HP-85 ROM DRAWER	33.25
HEW-17601A-085	HEW-27308-5	PERSONALITY MODULE-PLOTTER	641.25
HEW-17603A	HEW-27308-6	PLOTTER PERSONALITY MOD-RS232	641.25
HEW-17604A	HEW-27308-7	PERS MODULE 7225-COMM INT.	726.75
HEW-17055A	HEW-27310-0	OVERHEAD TRANSPARENCY KIT	84.55
HEW-09872-60066	HEW-27366-0	7225A DIGITIZING SIGHT	29.93
HEW-1540-0560	HEW-27560-V	7225B CARRYING CASE-ALONE	188.10
HEW-9111A	HEW-29111-A	GRAPHICS TABLET-HP83/85	1,667.25
HEW-82932A	HEW-51932-A	CARTRIDGE/MANUAL HOLDER	9.45
HEW-82933A	HEW-51933-0	HP85/83 CARRYING CASE	102.60
HEW-82948-0	HEW-51948-A	85/83 DUST COVER	14.20
HEW-92195A	HEW-55022-8	10 PACK 8IN DISKS FOR 9895	88.35
HEW-92190A	HEW-55022-S	10 PACK 5.25 DISKS FOR 8900	61.75
HEW-92155A	HEW-55155-A	2631B PRINTER RIBBON PKG3	52.25
HEW-17013A	HEW-56013-A	PLOT PAPER 15PADS8.5X11+PENS	80.75
HEW-9270-0639	HEW-57639-1	100-7225A TRANSPARENCY SHTS	18.95
HEW-5060-6810	HEW-58060-0	4 COLOR PEN PACK	5.69
HEW-5060-6894	HEW-58060-S	6 PLOT PENS MULTI COLORS	7.59
HEW-98200A	HEW-58200-1	HP85 TAPE CARTRIDGES,PKG OF 5	80.75

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MFG-PRODUCT CODE	STOCK #	DESCRIPTION	SPECIAL PRICE
HEW-9270-1006	HEW-58270-0	PLOT STD GRID PAPER 100 ENG	6.60
HEW-9270-1023	HEW-58270-1	PLOT STD GRID PAPER 100 METRIC	6.60
HEW-82931A	HEW-59200-1	HP-85 THERMAL PAPER-2 ROLLS	27.08
HEW-00085-13002	HEW-81300-2	HP-85 BASIC TRAINING APP PAC	80.75
HEW-00085-13003	HEW-81300-3	GENL STATISTICS-APPL PAC-HP85	80.75
HEW-00085-13004	HEW-81300-4	HP85 FINAN DECISIONS APP PAC	80.75
HEW-00085-13005	HEW-81300-5	MATH APPLICATION PAC-HP85	80.75
HEW-00085-13006	HEW-81300-6	HP-85 CIRCUIT ANALYSIS APP PAK	80.75
HEW-00085-13010	HEW-81301-0	HP85-GAMES APPLICATION PAC	80.75
HEW-00085-13011	HEW-81301-1	HP-85 LINEAR PROGRAM APP PAK	80.75
HEW-00085-13034	HEW-81303-4	HP85-TEXT EDITING APPL. PAC	80.75
HEW-00085-13035	HEW-81303-5	HP85 WAVEFORM ANALYSIS PAC	80.75
HEW-00085-13036	HEW-81303-6	BASIC STAT. & DATA MANIP PAC	80.75
HEW-00085-13037	HEW-81303-7	REGRESSION ANALYSIS APPLPAC	80.75
HEW-00085-13038	HEW-81303-8	GRAPHIC PRESENTATION PAC	170.05
HEW-00085-13042	HEW-81304-2	VISICALC PLUS PAC	161.50
HEW-00085-13046	HEW-81304-6	SERIES 80 SURVEYING PAC	152.00
HEW-00085-13057	HEW-81305-7	SERIES 80 GAMES II	80.75
HEW-45532A	HEW-8532-H5	HP GRAPHICS/125-5.25IN DISK	160.55
HEW-45533A-OPT 080	HEW-8533-H8	WORD/125-8IN DISK	403.75
HEW-45534A	HEW-8534-H5	HP LINK/125-5.25IN DISK	99.75
HEW-45534A-OPT 080	HEW-8534-H8	HP125 LINK/125-8IN DISK	99.75
HEW-45535A-OPT 080	HEW-8535-H8	BASIC/125-8IN DISK	261.25
HPC HEWLETT PACKARD CALCULATORS			
HPC-11C	HPC-10011-C	SLIM LINE PROG SCITIFIC W/MEM	113.05
HPC-12C	HPC-10012-C	SLIM LINE FINANCIAL W/MEM	122.55
HPC-32E	HPC-10032-E	SCIENTIFIC W/STATISTICS CALC	46.55
HPC-37E	HPC-10037-E	BUSINESS CALCULATOR	62.70
HPC-41C	HPC-10041-C	ALPHA/NUM PROG CALC	179.55
HPC-41CV	HPC-10041-V	ALPHA/NUM PROG CALC,MAX MEM	246.05
HPC-67	HPC-10067-A	PROGRAMMABLE CALCULATOR	299.25
HPC-82106A	HPC-14100-1	MEMORY MODULE	26.60
HPC-82170A	HPC-14104-1	QUAD MEMORY MODULE	80.75
HPC-82151A	HPC-14130-1	MODULE HOLDERS (2)	6.65
HPC-82120A	HPC-14140-1	MULTI RECHARGE BATTERY PK	26.60
HPC-82104A	HPC-28210-4	CARD READER FOR 41C/CV	170.05
HPC-82143A	HPC-28214-3	PRINTER FOR 41C/CV	303.05
HPC-82153A	HPC-28215-3	OPTICAL WAND-41C/CV	103.55
HPC-82160A	HPC-28216-0	HP-IL INTERFACE MODULE	103.55
HPC-82161A	HPC-28216-1	HPIL DIGITAL CASSETTE DRIVE	427.45
HPC-82162A	HPC-28216-2	HP-IL THERMAL PTR/PLOTTER	398.05
IES-SB/E	IES-8000-S3	ENHANCED CP/M BIOS-SUPRBRN	160.55
INT INTERTEC			
INT-SPRBRN-XRAM-VS3	INT-10030-1	64K SELF CONTAINED COMPTR-VS3	2,738.85
INT-SUPERBRAIN QD	INT-10034-X	QUAD 64K COMPUTER FACTORY TEST	3,130.25
INT-INTERTUBE-III	INT-22000-0	24X80 VIDEO TERMINAL	692.55
INT-EMULATOR	INT-23000-0	VID DISPLAY TERMINAL EMULATOR	692.55
INT-DSS 10	INT-50010-0	10 MEGABYTE WINCHESTER	3,130.25

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MFG-PRODUCT CODE	STOCK #	DESCRIPTION	SPECIAL PRICE
ITH ITHACA INTERSYSTEMS			
ITH-DPS-1	ITH-10000-0	S-100 MAINFRAME W/4MHZ CPU	1,771.75
ITH-DPS-1 FPL	ITH-10000-1	MAINFRAME/CPU-NO FRONT PANEL	1,448.75
ITH-PDS-80 SFP	ITH-11001-P	PASCAL DEV SYS-FP, SS DRVS	6,212.05
ITH-PDS-80 DFP	ITH-11002-P	PASCAL DEV SYS-FP D5 DRVS	6,778.25
ITH-M-BUG	ITH-31100-R	MONITOR PROM FOR Z80 CPU	25.65
ITH-MON303-R	ITH-31110-R	RELOCATABLE E-PROM MONITOR	25.65
ITH-64KDR-ASM	ITH-32064-A	64K DYNAMIC BD-250NS(816-2030)	802.75
ITH-FDC-2-ASM	ITH-33200-A	DOUBLE DENSITY CONTROLLER	398.05
ITH-VIO-1-ASM	ITH-34000-A	4P2S I/O W/INTERRUPTS	398.05
ITH-VIO-0-ASM	ITH-34002-A	4P2S I/O W/O INTERRUPTS	356.25
ITH-CABLE A	ITH-50010-0	CABLE-18 INCH W/2 FEM DB25S	46.55
ITH-CABLE B	ITH-50020-0	18 IN I/O CABLE W/DB37(FEM)	37.05
ITH-CABLE F	ITH-50060-0	CABLE-6 FOOT FOR 2 DSK DRVS	46.55
ITH-CP/M2-I1	ITH-8000-I1	CP/M 2.2 FOR FDC-2	142.50
ITH-IS-101	ITH-8000-K2	K2 DISK OPERATING SYSTEM(Z-80)	64.13
ITH-BIOS DISKETTE	ITH-8010-I1	CP/M 2.X BIOS FOR FDC-2	0.00
ITH-ASMBLE/Z-I1	ITH-8150-I1	RELOCATING Z-80 ASSEMBLER-CP/M	0.00
ITH-LINK/Z	ITH-8160-I1	Z-80 RELOCATING LINKER/LOADER	0.00
MOR MORROW			
MOR-DF 5224	MOR-10082-M	DEC I-2-QUAD DENS W/65K	3,371.55
MOR-DF 5124	MOR-11005-H	65K COMPUTER W/5 MEG HARD DISK	4,749.05
MOR-DF 5324	MOR-13005-H	3 USER DEC I W/5 MEG HARD DISK	6,265.25
MOR-SUPERRAM 16K/K	MOR-32017-K	16K STATIC RAM KIT	241.30
MOR-SUPERRAM 32K/A	MOR-32032-A	32K STATIC RAM ASM	423.70
MOR-DJ 2D-F800	MOR-33050-1	DD CONTROLLER-AT F800H	322.05
MOR-HARD DSK CONTR	MOR-33500-0	CONTROLLER-M26 HARD DISK	559.55
MOR-SWITCHBOARD/A	MOR-34010-A	4PIO 2SIO SYSTEM BD/A	213.75
MOR-ADD-ON DRV-TAN	MOR-40100-1	SHUGART 8IN DRV TAN CAB W/PS	616.55
MOR-DUAL ADD ON	MOR-40100-3	2 8' DRVS,DD,SS, 1 CAB W/PS	1,205.55
MOR-2+2 ADD-ON-TAN	MOR-40102-1	QUAD 8IN DRV IN CAB W/PS TAN	939.55
MOR-DUAL DRV CABLE	MOR-40200-2	CABLE FOR 2 DRIVES TO CONTR	29.45
MOR-QUAD DRV CABLE	MOR-40200-4	CABLE FOR 4 DRIVES TO CONTR	47.50
MOR-DISC2D-TAN-F800	MOR-41000-2	DP DISK SYSTEM-AT F800H	853.10
MOR-DUAL DISC2D-SL	MOR-41010-0	TWO 8IN DD DRV/SLIM CAB/PS	1,471.55
MOR-DUAL DISC2D-TD	MOR-41010-1	TWO DD 8IN DSK SYS DUAL CAB/PS	1,471.55
MOR-DL DIS2D-TS-F8	MOR-41016-2	2 DDSS 8IN DISK SYS @F800	1,471.55
MOR-DL DISK-TD-F8	MOR-41016-4	2 DD 8' DSK SYS @ F800	1,471.55
MOR-DISCUS2+2-TAN-A	MOR-42000-A	QUAD DENSITY 8 IN DSK SYSTEM	1,177.05
MOR-DL DISC2+2-T-A	MOR-42010-A	2 QUAD DENS 8IN DSKS-2TAN CABS	2,032.05
MOR-M26	MOR-45000-0	26 MEGABYTE WINCHESTER + CONTR	3,605.25
MOR-M26-BLANK I/O	MOR-45000-1	26 MEGABYTE WINCHESTER + CONTR	3,605.25
MOR-M5-BLANK I/O	MOR-45005-1	5 MEG WINCHESTER + CONTROLLER	1,990.25
MOR-M10-BLANK I/O	MOR-45010-1	10 MEG WINCHESTER HD & CONTR	2,940.25
MOR-CP/M-DISCUS I	MOR-8000-L1	CP/M FOR DISCUS I AND DJ 1	104.50
MOR-CP/M-DISCUS 2D	MOR-8110-I2	CP/M FOR DISCUS 2D AND DJ 2D	128.25
MOR-CP/M-SOL/DISC2D	MOR-8130-I2	CP/M FOR DISCUS 2D AND SOL	128.25
MOR-2D CP/M 2.0	MOR-8200-I1	CP/M 2.0 FOR DISCUS 2D	128.25
MOR-CP/M-I1-F800	MOR-8210-I1	CP/M 2.X FOR 2D-@ F800H	128.25
MOR-CP/M2.X-F0-I1	MOR-8230-I1	CP/M 2.X FOR DJ 2D @ F000	128.25
MOR-BASIC-80	MOR-8510-I1	MICROSOFT BASIC FOR DISCUS	241.30

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MFG-PRODUCT CODE	STOCK #	DESCRIPTION	SPECIAL PRICE
NEC NEC PRINTERS			
NEC-3510-1	NEC-27510-1	30 CPS RS-232 PRINTER	1,847.75
NEC-3515-1	NEC-27515-1	30 CPS DIABLO COMP RS232 PRTR	1,847.75
NEC-3530-1	NEC-27530-1	30CPS CENT/PAR RS232 PRINTER	1,847.75
NEC-7710-1	NEC-27710-1	SPINWRITER-RO, FRICT, RS232	2,275.25
NEC-7730-1	NEC-27730-1	LETTER QUAL PRINTER-CENT COMP	2,275.25
NEC-FORMS TRACTOR	NEC-29100-0	TRACTOR OPT FOR NEC PRINTERS	190.00
NEC-BI-DIR TRACTOR	NEC-29100-1	BI DIRECTIONAL FORMS TRACT OPT	323.00
NOR NORTHSTAR COMPUTERS			
NOR-HRZ 2-64K-Q-W-A	NOR-10082-0	HRZ-2-QUAD DENS W/64K-FC(WOOD)	2,991.55
NOR-HRZ2 64K-Q-M-A	NOR-10082-M	HRZ2 QUAD DENS W/64K-FC(METAL)	2,896.55
NOR-HDS-18	NOR-10090-1	ADDITIONAL 18MB HARD DISK	4,340.55
NOR-HDS-5	NOR-10095-1	5 MEG HARD DISK UPGRADE	2,374.05
NOR-HRZ-EC4-KIT	NOR-10101-K	4 S-100 EDGE CONNECTORS	16.15
NOR-HRZ-UPS-KIT	NOR-10201-K	UNIVERSAL POWER SUPPLY KIT	33.25
NOR-HRZ-SIO-KIT	NOR-10301-K	2ND SERIAL PORT OPTION KIT	33.25
NOR-HRZ-PIO-KIT	NOR-10401-K	8-BIT PARALLEL PORT OPT KIT	33.25
NOR-HRZ-DRV-Q-KIT	NOR-10503-K	ADD-ON QUAD DRIVE FOR HORIZON	551.00
NOR-HRZ-CABLE	NOR-10700-1	CABLE TO ADD 3RD DRIVE	41.80
NOR-ADV-2Q-64K	NOR-11000-0	64K COMPUTER-2 5IN D DRVS	3,225.25
NOR-HRZ-1-Q-HD5	NOR-11005-H	HORIZON W/5 MEG HARD DISK	5,271.55
NOR-00862	NOR-11862-1	ADV SIO BOARD	141.55
NOR-HRZ-1-Q-HD18-4	NOR-14018-H	4 USER HRZ W/18 MEG HARD DISK	8,260.25
NOR-ZPB-KIT	NOR-31001-K	Z80A PROCESSOR BOARD KIT	160.55
NOR-RAM-16-ASM	NOR-32016-A	16K DYNAMIC RAM (4 MHZ) ASM	399.00
NOR-RAM-16-ASM-PAR	NOR-32018-A	16K DYNAMIC RAM(4MHZ)W/PARITY	280.25
NOR-HRAM-32K	NOR-32032-0	32K DYNAMIC RAM BOARD	398.05
NOR-RAM-32-ASM	NOR-32032-A	32K DYNAMIC RAM (4 MHZ) ASM	589.00
NOR-RAM-32-KIT	NOR-32033-K	32K DYNAMIC RAM (4 MHZ) KIT	474.05
NOR-HRAM-64K	NOR-32064-0	64K DYNAMIC RAM BOARD	559.55
NOR-RAM-16-PAR-KIT	NOR-32117-K	RAM-16 PARITY CHECKING OPT KIT	33.25
NOR-MDS-CTRL-D-ASM	NOR-33010-A	DOUBLE DENSITY CONT ASM	455.05
NOR-HSIO-4	NOR-34004-0	4 PORT SERIAL I/O BD	280.25
NOR-FPB-A-ASM	NOR-39010-A	FLOATING POINT BD ASM	322.05
NOR-MDS DRV-Q-KIT	NOR-40103-K	EXTRA QUAD DRV-MDS SYSTEM	584.25
NOR-MDS-PS-KIT	NOR-40301-K	MDS POWER SUPPLY KIT	33.25
NOR-MDS-CAB-PS-KIT	NOR-40403-K	MDS SGL CAB W/PS FOR 5IN DRV	80.75
NOR-ADC-1-Q-M-A	NOR-40422-M	DUAL CAB/PS W/QUAD DRV-METAL	628.90
NOR-ADC-2-D-ASM	NOR-40430-A	DUAL CABINET W/2 MDS DR INST	1,087.75
NOR-DISKETTE-20-Q	NOR-51000-4	20 PACK DBL SIDE/DBL DENS	118.75
NOR-TSS/A	NOR-8000-N2	MULTI-USER DOS	398.05
NOR-TSS/C	NOR-8003-N2	00886-MULTI-USER OP. SYS.	393.30
NOR-G CP/M-A2	NOR-8020-A2	00790-GRAPHICS CP/M2-ADVANTAGE	236.55
NOR-MDS-PERS-DQ-SOL	NOR-8160-N2	CONFIGURED SYS DISK-DQ-SOL20	9.50
NOR-MDS-PERS-SOL20	NOR-8160-NI	CONFIGURED SYS DISK-SOL20	9.50
NOR-PASCAL-DQ	NOR-8200-N2	PASCAL FOR HORIZON-DQ W/UTIL	160.55
NOR-PAS-UPGR-A-DQ	NOR-8201-N2	UPGRADE PASCAL-D (1.0) TO DQ	42.75
NOR-PAS-PRI-S	NOR-8250-N1	USDC PASCAL FOR NS PRIMARY-SD	42.75

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NOR-PAS-AUX-S	NOR-8260-N1	USDC PASCAL FOR NS AUX-SD	25.65
NOR-NORTHWORD-DQ	NOR-8501-N2	WORD PROCESSING SYS FOR HRZ	322.05
NOR-MAILMANAGER-DQ	NOR-8502-N2	MAILING SYSTEM FOR HORIZON	236.55
NOR-INFO MANAGER-DQ	NOR-8503-N2	DATA MANAGEMENT SYS FOR HRZ	398.05
NOR-G/L-DQ	NOR-8504-N2	GENERAL LEDGER FOR HRZ	759.05
NOR-A/R-D	NOR-8505-N2	ACCOUNTS RECEIVABLE FOR HRZ DD	474.05
NOR-A/R-Q	NOR-8506-N4	ACCTS RECEIVABLE FOR NS QUAD	474.05
NOR-A/P-D	NOR-8507-N2	ACCOUNTS PAYABLE FOR HRZ-DD	474.05
NOR-A/P-Q	NOR-8508-N4	ACCOUNTS PAYABLE FOR HRZ-QD	474.05
NOV NOVATION			
NOV-4102D	NOV-74102-4	300 BPS ORIG ONLY DIR MODEM	294.50
NOV-4202B(#490142)	NOV-74202-B	MODEM,1200BPS 2/4WAUTO ANS,DC	489.25
NOV-CAT-490190	NOV-75000-0	ANSWER/ORIGINATE MODEM	141.55
NOV-D-CAT (490268)	NOV-75000-1	DIRECT CONNECT MODEM-ANS/ORIG	147.25
NOV-APPLE CAT	NOV-75100-A	APPLE 300/1200 BAUD MED/COMM	312.55
NOV-AUTO-ANS D-CAT	NOV-75100-D	300 BAUD MODEM,AUTO/ANS DIRECT	208.05
OKI OKIDATA			
OKI-MICROLINE-80	OKI-22080-0	DESK TOP DOT-MATRIX PRINTER	369.55
OKI-MICROLINE80-22D	OKI-22080-1	DESK TOP DOT MATRIX PRTR 220V	616.55
OKI-82A	OKI-22082-A	DOT MATRIX PRINTER	521.55
OKI-MICROLINE 83A	OKI-22083-A	SER/PAR DOT MAT W/TRAC PRTR	806.55
OKI-84A	OKI-22084-A	SER/PAR DOT MATRIX/200 CPS	1,139.05
OKI-MSP-100	OKI-22280-0	PAR/SERIAL ADAPT-OKI ML-80	103.55
SOR SOROC			
SOR-IQ 120-STD	SOR-21200-0	VIDEO TERMINAL-STANDARD	692.55
SOR-IQ 130-STD	SOR-21300-0	PROGRAMMABLE VIDEO TERMINAL	569.05
SOR-IQ 135-STD	SOR-21350-0	VIDEO TERMINAL, FUNCTION KEYS	711.55
SOR-IQ-135 W/GRAPH	SOR-21351-0	IQ-135 TERM W/FUNC KEYS,GRAPH	759.05
SOR-IQ 140-STD	SOR-21400-0	VIDEO TERMINAL-STANDARD	1,091.55
TIC TEXAS INSTRUMENTS			
TIP-810-BSC	TIP-20000-0	RD SERIAL IMPACT PRINTER	1,281.55
TIP-810-BSC/PLT	TIP-20000-2	RO IMPACT PRINTER/SERIAL+PAR	1,324.30
TIP-INSIGHT	TIP-22010-0	SERIES 10 INFORMATION TERMINAL	802.75
TIP-202	TIP-25202-I	810-EXPANDED CHAR SET-OPT-INST	85.50
TIP-202-KIT	TIP-25202-K	810-EXPANDED CHAR SET OPT-KIT	85.50
TIP-303-KIT	TIP-25303-K	810-PARALLEL INTERFACE OPT-KIT	128.25
TIP-601-KIT	TIP-25601-K	810 TEAR BAR OPT-100 COL-K	34.20
TIP-745-STD	TIP-27450-0	745 PORT TERM-LTD ASCII KBD	1,329.05
TIP-745-FUL	TIP-27450-1	745 PORTABLE DATA TERM-U/L CSE	1,420.25
TIP-785	TIP-27850-0	PORT. DATA TERMINAL-1200 BAUD	1,965.55
TIP-820 RO-STD	TIP-28200-0	BASIC 820 RO PRINTER	1,562.75
TIP-820(KSR) BASIC	TIP-28210-0	BASIC MODEL 820 (KSR)	1,747.05
TIP-820KSR PACKAGE	TIP-28210-1	820KSR TERM W/FUL/COMP PR/DFC	1,952.25
TIP-840 KSR BASIC	TIP-28410-0	75 CPS SERIAL PRINTER/TERM	1,002.25
TIP-840KSR TRAC PKG	TIP-28410-1	75 CPS SER PRT W/TRACT, DFC	1,367.05

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MFG-PRODUCT CODE	STOCK #	DESCRIPTION	SPECIAL PRICE
TIP-940 BASIC	TIP-29940-0	EDITING,VIDEO DISPLAY TERMINAL	1,519.05
TIP-608	TIP-50608-1	OMNI800 MACHINE MTD PAPER TRAY	20.90
TIP-610	TIP-50610-1	OMNI 800 TERMINAL STAND	60.56
TIP-613	TIP-50613-1	MACHINE-MTD PAPER TRAY-825	20.90
TVI TELEVIDEO			
TVI-TS-801	TVI-10082-0	Z-80 64K COMP W/DS MINIFLOPPY	3,035.25
TVI-TS-806	TVI-16006-H	6 USER COMP 9.6M WIN QD MF	5,746.55
TVI-TS-800	TVI-16010-1	Z-80 INTELLIGENT WK STA	1,610.25
TVI-TS-802	TVI-16030-1	Z-80 DESKTOP DUAL QD MINIFLP	2,820.55
TVI-TS-802H	TVI-16030-H	Z-80 DESKTOP W/5MEG QUAD	5,647.75
TVI-910	TVI-20910-1	LOW COST VIDEO TERMINAL	565.25
TVI-912B	TVI-20912-0	24X80 VIDEO TERMINAL	702.05
TVI-912C	TVI-20912-1	24X80 VIDEO TERM/SELECTRIC KBD	702.05
TVI-920C	TVI-20920-1	VID TERM,FUNCTION KEYS,SEL KBD	749.55
TVI-925C	TVI-20925-1	VIDEO TERM-SEPARATE KEYBOARD	749.55
TVI-950C	TVI-20950-1	VID TERM,FUNCTION KEYS,SEP KBD	939.55
TVI-950 MEM	TVI-20953-K	3 XTR PG MEMORY	141.55
ZEN ZENITH			
ZEN-Z-47-DA	ZEN-40047-0	DSDD FLOPPY DISK SYS-Z-89	2,982.05
ZEN-Z-88-7	ZEN-40147-1	UPGR PROM-Z-89-AA/CA FOR Z47	42.75
ZEN-Z-89-6	ZEN-40187-1	UPGR PROM-Z-89-AA/CA FOR Z87	42.75
ZEN-ZYM-121	ZEN-60121-0	12IN B & W MONITOR (APPLE TAN)	118.75
ZEN-HMP-817-2	ZEN-8500-Z1	WORDSTAR(CP/M) ON 5.25 DISKS	312.55
ZEN-HMP-817-3	ZEN-8510-Z1	MICRO-PRO MAILMERGE-5IN	109.25
SDS SD SYSTEMS			
SDS-38028	SDS-31002-A	SBC200 SINGLE BD COMP(4MHZ)ASM	380.00
SDS-27001	SDS-32165-K	EXPANDORAM KIT (NO RAM)	205.20
SDS-38005	SDS-33100-A	VERSAFLOPPY I-SINGLE DENS-ASM	305.90
SDS-38024	SDS-33200-A	VERSAFLOPPY II DBL DENSITY-ASM	409.45
SDS-38011	SDS-33250-8	CABLE-VF TO 2 8IN DRIVES	84.55
SDS-38025	SDS-35100-A	PROM-100 PROM PROGRAMMER-ASM	250.80
SDS-38013	SDS-37000-A	VDB-8024 VIDEO DISPLAY BD-ASM	445.55
SDS-38029	SDS-37000-X	VDB-8024-50HZ VIDEO DISPLAY BD	445.55
SDS-38007	SDS-39000-A	Z80 STARTER SYSTEM-ASM	428.45
SDS-27004	SDS-39001-K	Z80 STARTER KIT	323.95
SDS-MPC-4-A	SDS-39100-A	BUFFERED I/O W ON BOARD Z-80	616.55
SDS-39006	SDS-70006-R	MONITOR FOR SBC-100 W/RS232	19.00
SDS-39007	SDS-70007-R	MONITOR FOR SBC-100 W/VDB-8024	19.00
SDS-39008	SDS-70014-R	DBIOS-SOFTWARE-5IN DSK/RS232	80.75
SDS-39010	SDS-70016-R	DBIOS-8IN DISK/RS232 CONSOLE	80.75
SDS-39034	SDS-70020-R	DDBIOS-VEII CONTROL SOFTWARE	80.75
SDS-39012	SDS-70042-R	VDIAG2-VERSAFLOPPY DIAGNOSTICS	80.75
SDS-39001	SDS-8000-LS	CP/M VFI-5 & 8INCH DISK	80.75
SDS-39029	SDS-8020-I1	SDOS-8IN SD OS-RS232 CONSOLE	161.50
SDS-39030	SDS-8021-I1	SDOS-8IN SD OS/VDB8024 CONSOLE	161.50
SDS-39032	SDS-8040-I4	SDOS-8IN DD,DBL-SIDED W/CBASIC	242.25
SDS-39046	SDS-8080-I1	CP/M 2.X FOR VERSAFLOPPY-8 IN	202.35
SDS-39066	SDS-93902-D	Z-80 STARTER KIT WORKBOOKS	23.75

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MFG-PRODUCT CODE	STOCK #	DESCRIPTION	SPECIAL PRICE
SSM SOLID STATE MUSIC			
SSM-CB2-A&T	SSM-31020-A	Z-80 CPU-ASM	274.55
SSM-CB2-KIT	SSM-31021-K	Z-80 CPU-KIT	208.05
SSM-IO2-A&T	SSM-34002-A	PARALLEL I/O INTERFACE-ASM	79.80
SSM-IO2-BARE BOARD	SSM-34003-N	PARALLEL I/O INTERFACE-BARE BD	31.35
SSM-IO4-A&T	SSM-34004-A	2P+2S I/O INTERFACE-ASM	234.65
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Morrow Hard Disks from MiniMicroMart now feature CP/M, Microsoft BASIC, and WordStar.

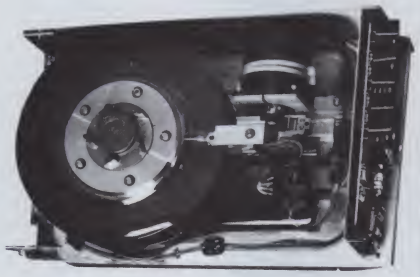
New 5 Megabyte Hard Disk for S-100 systems with DMA control.

Morrow has introduced a new 5¼" Winchester subsystem with 5 meg of storage featuring a new DMA controller. They're small in size and low in price.

The Morrow Discus M-5 list is $2,495. MiniMicroMart offers it for only **$2,095.**

If you consider the value of the software that MiniMicroMart includes, you'll realize that you're getting the system for about the price of a floppy disk system.

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New Floppy Disk Subsystems from Morrow Designs...

Morrow Designs, an early leader in floppy disk subsystems has come up with some new winners; it's now two for one. These are two drives in virtually the same cabinet that used to house a single 8" drive. These new disk systems are available in both single and double sided; they draw less power, generate less heat, and therefore, should be more reliable. The systems use a new series of drives - half the thickness of the old one. The new compact systems are priced the same as regular Discus 2-D systems.



Morrow Introduces New DMA Floppy Disk Controller Supporting Large and Small Drives.

Last year, Morrow introduced a new super disk controller; it not only supports both 5¼" and 8" drives simultaneously, but it also is the only controller that can be programmed to read virtually any format. For example, it could read NorthStar CP/M disks, Micropolis CP/M, as well as 5¼ Cromemco and others. Morrow has been slow to get this controller into production but we have made special arrangements to get early shipments of this unit in large quantities.

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Finally, an economical 5 megabyte Winchester hard disk system that can be used with virtually any computer, including the Apple without any need for software changes. The Konan David Subsystem works with Apple DOS, Pascal, and CP/M -- in fact, the same disk can have them resident at the same time.

Other systems supported are TRS-80's, the Xerox 820, all S-100 CP/M systems, and soon the Superbrain. The David is one of the smallest Winchester subsystems packages, and is aesthetically pleasing. A write protect switch is on the front of the drive, as is an LED showing disk activity. The interface provides for write precompensation, error correction using 32 bit polynomial, 11 bit burst ECC, it also features automatic flaw mapping and tracking for increased data reliability.

The Konan David Subsystem has a list of $2,995 and is available from MiniMicroMart...
our price **$2,499**

For those who need more storage capacity, a 10 megabyte version lists for $3,650...
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The 15 megabyte version lists for $3,975...
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The CP/M patch for the Apple is an additional $29. The S-100 version of any of the disk subsystems (with a CP/M patch) is an additional $129.

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MiniMicroMart supplies most of the above software on the more popular 5¼" CP/M formats such as NorthStar (single and double density), Micropolis/Vector Graphic (16 Sector), Cromemco, SuperBrain (DOS 3.0), Heath/Zenith Z-89, and Televideo Systems. In most cases there is an extra charge for the 5¼" conversions; there are always extra charges of $10 per disk where the conversion takes more than one minifloppy.

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Alternative to Atari's Disk System

By Gary Douchant

A disk system is an integral part of a working computer system. Unfortunately, many people may be reluctant to buy a microcomputer because such peripherals can be expensive. The Atari may very well be the solution to the needs of the initial user.

Consider the possibilities of an Atari with a cassette recorder capable of using I/O related functions other than loading and saving programs. The ability to read and write data from the cassette recorder is a powerful feature. With the Atari you can create tape files containing numeric and string data.

The necessary routines are very straightforward. In fact, once you see how easy it is to use them, you'll find a host of projects to start.

What follows here is a sample routine to write numeric and string data to tape, a sample routine to input the aforementioned data and a typical example of the capabilities of using I/O routines with the cassette recorder. These routines were developed on the Atari 800 with the aid of the Basic Reference Manual, pp. 23-28.

```
100 DIM ITEM$(20)
110 REM OPEN FILE FOR OUTPUT
120 OPEN #3,8,0,"C:"
130 REM WRITE DATA TO TAPE
140 GOSUB 200
150 REM CLOSE FILE FOR OUTPUT
160 CLOSE #3
170 END
200 READ ITEM$,COST
205 PRINT ITEM$,COST
210 PRINT #3;ITEM$
215 PRINT #3;COST
220 IF ITEM$="/*" AND COST=0 THEN RETURN
230 GOTO 200
500 DATA EGGS,80
510 DATA BREAD,75
520 DATA BACON,150
530 DATA /*,0
```

Listing 1.

The Output Routine

First, we have an output routine which consists of the following statements as represented in Listing 1. A number of observations about the output routine follow:

- Line 100 will dimension a string of length 20.
- Line 120 and line 160 are used to open and close file 3 for output to the cassette recorder.
- Lines 200 through 230 are used to read two values (one a character string and the other a number) from data statements. These values are written to tape. The end-of-data markers will consist of the character string "/*" and a numeric value of zero. Data is read and written to tape until the end-of-data markers are encountered.
- Line 205 is only used to display the fields read from the data statements and has no effect on the data written to tape.

Once you've typed in Listing 1, you need to insert a tape in the cassette recorder. Type run and press return to execute the program. You will hear two beeps; press the record and play buttons on the recorder. In a few moments READY will display on the screen. The data has now been written to tape. Press stop on the recorder and rewind the tape to the original position.

To read the data from the tape, you'll need an input program. The input statements in this program are used to read the data in the same sequence that the data was written. Note that the output and input routines are very similar.

An equivalent input routine would contain statements similar to that in Listing 2. Review this routine and compare it with the output routine. Consider the following points:

- In line 120 I have arbitrarily selected 4 as the input file number.
- Lines 200 through 240 are used to input the fields until the end-of-data markers are encountered.
- Line 230 is used to display the fields as they are read.

To read data from tape, type in this program, type run and press return. You will hear one beep to signify that the play button on the recorder is to be pressed. The program is finished once READY appears on the screen. Press the stop button on the recorder.

This input routine will display the

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data read from tape. Other routines may very well have arrays to store the data for later processing. Arrays can be used to formulate reports, sort the data into a particular sequence, insert/delete data to create a new dataset, etc.

The following program includes both routines as well as others to demonstrate how easily you can create and use data files. And just think: all this is possible with the cassette recorder. Once you understand what is involved, the next step is to take a close look at all of those programs requiring data files that you wish to implement.

```
100 DIM ITEM$(20)
110 REM OPEN FILE FOR INPUT
120 OPEN #4,4,0,"C:"
130 REM INPUT DATA FROM TAPE
140 GOSUB 200
150 REM CLOSE FILE FOR INPUT
160 CLOSE #4
170 END
200 INPUT #4,ITEM$
210 INPUT #4,COST
220 IF ITEM$="/*" AND COST=0 THEN RETURN
230 PRINT ITEM$,COST
240 GOTO 200
```

Listing 2.

The following summarizes the program contained in Listing 3:

- The GOSUB at 1200 will print the menu. Valid entries consist of the digits 1, 2 or 3.
- The GOSUB at 2000 will input data and produce a report. The curved arrow is the means necessary to clear the screen. This is done by pressing the ESC key followed by the shift and clear keys.
- The GOSUB at 2300 contains the logic necessary to input data. The input routine will follow the structure of the output routine. This routine expects the first value to be numeric. This number is the counter that indicates how many numeric values fol-

Listing 3.

```
10 REM SAMPLE ATARI PROGRAM TO
20 REM DEMOSTRATE THE I/O FEATURES
30 REM USING THE CASSETTE RECORDER
40 REM
50 REM AUTHOR:  GARY DOUCHANT
60 REM DATE:    AUGUST 20, 1980
70 REM
100 REM DIMENSION ARRAYS AND STRINGS
110 DIM ITEM$(25),ANS$(1),COST$(10)
120 DIM DESCTABLE$(500)
130 DIM CTABLE(25)
140 REM
200 REM VARIABLE LIST
210 REM COST
220 REM I
230 REM CTCOMMA
240 REM NUMINPUT
250 REM CTINPUT
260 REM PTABLE
270 REM J
280 REM TOTCOST
```

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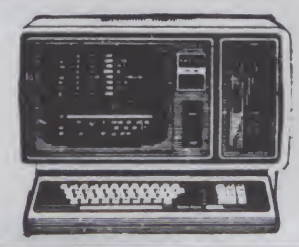
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low and how many character strings exist. If the first number was 20, then 20 numeric values and 20 character strings would be read. Line 2440 is used to blank out any stray graphics characters (ATASCII 0). Array CTABLE will contain the set of costs. String DESCTABLE$ will contain the set of items.

- The GOSUB at 2600 is used to print the report for the data just read. The bar graphics character is used in order to simplify the print routine. Line 2945 is a delay to display the output.
- The GOSUB at 3200 will sum the costs and set each cost to an equivalent character string.
- The GOSUB at 4000 is used to format the string for output.
- The GOSUB at 5000 contains the logic to output data to tape. This program expects the item to consist of a string up to 24 characters. The cost must be entered with the cents figure even if it is zero. Each cost is written as the cost times 100.
- The character in line 2440 is obtained from a control/comma. The vertical bar in line 2920 is the result of a shift/equal.■

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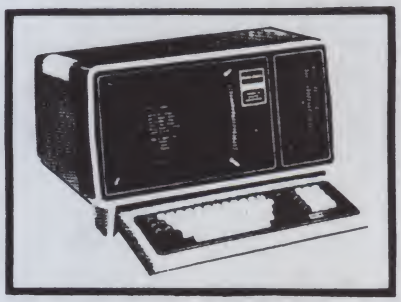
```
290 REM TEMP
999 REM PROGRAM
1000 GOSUB 1200
1020 IF ANS$(1,1)="1" THEN GOSUB 2000:GOTO 1000
1030 IF ANS$(1,1)="2" THEN GOSUB 5000:GOTO 1000
1040 IF ANS$(1,1)="3" THEN END
1050 PRINT "INVALID OPTION - TRY AGAIN"
1060 FOR I=1 TO 200:NEXT I
1070 GOTO 1000
1199 REM I/O MENU
1200 GRAPHICS 0:SETCOLOR 4,10,4
1210 POSITION 0,2
1220 PRINT "      I/O MENU":PRINT
1230 PRINT "(1)  INPUT DATA"
1240 PRINT "(2)  OUTPUT DATA"
1250 PRINT "(3)  EXIT":PRINT
1260 PRINT "      FUNCTION:  "
1270 INPUT ANS$
1280 RETURN
1999 REM INPUT DATA
2000 PRINT "↰":SETCOLOR 4,4,4
2010 PRINT
2020 PRINT "Insert tape for input."
2030 PRINT
2040 PRINT "Position tape to beginning of file."
2050 PRINT
2060 PRINT "Ready to procede (Y/N)"
2070 INPUT ANS$
2080 IF ANS$(1,1)="Y" THEN GOTO 2140
2090 IF ANS$(1,1)="N" THEN GOTO 2000
2100 PRINT "INVALID OPTION - TRY AGAIN"
2110 FOR I=1 TO 200:NEXT I
2120 GOTO 2000
2130 REM
2140 PRINT :PRINT "Press PLAY on the recorder"
2150 PRINT :PRINT "Follow this with the RETURN key"
2160 PRINT :PRINT "Wait - the data is about to be read"
2170 OPEN #4,4,0,"C:"
2180 REM INPUT DATA FROM TAPE
2190 GOSUB 2300
2200 CLOSE #4
2210 REM PROCESS DATA
2220 GOSUB 2600
2230 RETURN
2240 REM
2300 REM 1ST IS NUMBER OF VALUES
2310 REM 2ND IS THE SET OF NUMBERS
2320 REM 3RD IS THE SET OF STRINGS
2350 INPUT #4,NUMINPUT
2370 FOR I=1 TO NUMINPUT
2380 INPUT #4,COST
2390 CTABLE(I)=COST
2400 NEXT I
2410 FOR I=1 TO NUMINPUT
2420 INPUT #4,ITEM$
2430 FOR J=1 TO 25
2440 IF ITEM$(J,J)="●" THEN ITEM$(J,J)=" "
2450 NEXT J
2460 DESCTABLE$(I*25-24,I*25)=ITEM$
2470 NEXT I
2480 RETURN
2599 REM REPORT ROUTINE
2600 PRINT "↰"
2610 IF NUMINPUT=0 THEN PRINT "NO DATA TO PROCESS":RETURN
2620 IF NUMINPUT<0 THEN RETURN
2630 REM PRINT HEADERS
2640 POSITION 5,1
2650 PRINT "ATARI PRODUCT"
2660 POSITION 30,1
2670 PRINT "COST"
2680 POSITION 5,2
2690 PRINT "_____"
2700 POSITION 30,2
2710 PRINT "____"
2720 REM
2730 CTINPUT=0:PRINT :PRINT
2740 CTINPUT=CTINPUT+1
2750 IF CTINPUT>NUMINPUT THEN GOTO 2900
2780 GOSUB 3200
```

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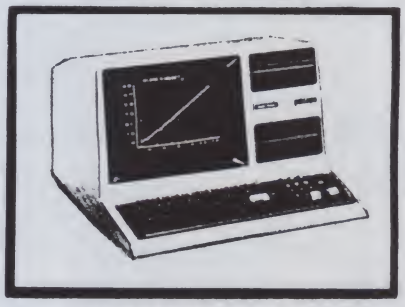
Listing 3 continued.

```
2790 GOTO 2740
2900 PRINT :PRINT "                                    ":PRINT
2910 ITEM$="                TOTAL"
2920 ITEM$(25,25)="|"
2930 COST$=STR$(TOTCOST):GOSUB 4000
2940 PRINT ITEM$;COST$
2945 FOR I=1 TO 700:NEXT I
2950 RETURN
3200 PTABLE=CTINPUT*25-24
3210 ITEM$=DESCTABLE$(PTABLE,PTABLE+24):ITEM$(25,25)="|"
3220 TOTCOST=TOTCOST+CTABLE(CTINPUT)
3230 COST$=STR$(CTABLE(CTINPUT))
3240 GOSUB 4000
3250 PRINT ITEM$;COST$
3260 RETURN
4000 J=10:CTCOMMA=0
4010 FOR I=LEN(COST$) TO 1 STEP -1
4020 IF J=0 THEN PRINT "STRING LEN ERROR":END
4030 IF J=8 THEN COST$(J,J)=".":J=J-1:CTCOMMA=0
4040 IF CTCOMMA=3 THEN COST$(J,J)=",":J=J-1:CTCOMMA=0
4050 COST$(J,J)=COST$(I,I)
4060 CTCOMMA=CTCOMMA+1
4065 J=J-1
4070 NEXT I
4080 REM BLANK OUT REST OF STRING
4090 FOR I=J TO 2 STEP -1
4100 COST$(I,I)=" "
4110 NEXT I
4120 REM INSERT DOLLAR SIGN
4130 COST$(1,1)="$"
4140 RETURN
4999 REM OUTPUT DATA
5000 PRINT "↖":SETCOLOR 4,12,4
5010 PRINT
5020 PRINT "Insert tape for output."
5030 PRINT
5040 PRINT "Position tape to beginning of file."
5050 PRINT
5060 PRINT "Ready to procede (Y/N)"
5070 INPUT ANS$
5080 IF ANS$(1,1)="Y" THEN GOTO 5140
5090 IF ANS$(1,1)="N" THEN GOTO 5000
5100 PRINT "INVALID OPTION - TRY AGAIN"
5110 FOR I=1 TO 200:NEXT I:GOTO 5000
5120 REM
5140 PRINT :PRINT "Enter the item and the cost."
5150 PRINT
5160 PRINT "ITEM - string for text field"
5170 PRINT
5180 PRINT "COST - dollars and cents of item"
5190 PRINT
5200 PRINT "When finished enter - /* as the ITEM"
5210 PRINT "-----------------------------------"
5220 CTINPUT=0:DESCTABLE$(1,500)=" ":ITEM$(1,25)=" "
5225 DESCTABLE$(500,500)="|"
5230 CTINPUT=CTINPUT+1:PRINT
5240 PRINT "Item is:":INPUT ITEM$
5250 IF ITEM$="/*" THEN GOTO 5300
5260 PTABLE=CTINPUT*25-24
5270 DESCTABLE$(PTABLE,PTABLE+24)=ITEM$
5280 PRINT "Cost is:":INPUT COST
5290 CTABLE(CTINPUT)=COST:GOTO 5230
5300 PRINT :PRINT "Press PLAY and REC on the recorder"
5310 PRINT :PRINT "Follow this with the RETURN key"
5320 PRINT :PRINT "Wait - the data is about to be saved"
5330 OPEN #3,8,0,"C:"
5340 NUMINPUT=CTINPUT-1
5350 PRINT #3;NUMINPUT
5360 FOR I=1 TO NUMINPUT
5370 TEMP= CTABLE(I)*100
5380 PRINT #3;TEMP
5390 NEXT I
5400 FOR I=1 TO NUMINPUT
5410 ITEM$=DESCTABLE$(I*25-24,I*25)
5420 PRINT #3;ITEM$
5430 NEXT I
5440 CLOSE #3
5450 RETURN
```

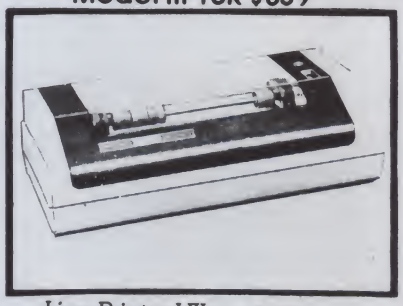

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Machine Code At Your Fingertips

By Jonathan M. Kraushaar

Many microcomputerists choose the Basic language, because it's easy to use. But machine language is often needed to speed execution, to perform specialized tasks or to design microprocessor controllers and peripheral devices.

The common method of preparing a machine-language or symbolic program for execution requires an assembler or compiler, but this approach may be costly. I have developed a Basic program for the 4K Radio Shack Color Computer (see the program listing) to ease preparation and entry into memory of a machine- or assembly-language program. The program will, with modifications, run on other micros that have a Basic interpreter.

A machine-language program uses the instruction set and registers of the microprocessor on which it is run to perform operations on data in memory. A typical home computer uses a Basic interpreter to allow higher-level program entry. The machine-code instruction set of the Radio Shack Color Computer, which uses the Motorola 6809 microprocessor, is described in the March 1981 issue of *Byte*. Motorola publishes a description, available free from the company, of all the instructions, and a 6809 programming manual is available for a nominal charge. (Motorola Semiconductor Products, Inc., P.O. Box 20912, Phoenix, AZ 85036.)

Once a program has been prepared from the instruction set it must be inserted into memory and can then be executed. Kits are now available to do this using a hexadecimal keyboard and an LED (light-emitting diode) display, but program editing is tedious. The Radio Shack Color Computer is priced not much above the typical microprocessor kits, and the Color Computer includes a full video

Program listing. Basic program to prepare and run machine-code programs for the Color Computer.

```
10 REM THIS PROGRAM PUTS A MACHINE CODE PROGRAM INTO MEMORY
20 PRINT "TYPE IN START MEMORY LOCATION FOR MACHINE PROGRAM:"
30 INPUT NO
40 READ N,I$,J
50 IF LEN(I$)=0 THEN GO TO 360
60 A$=LEFT$(I$,2)
70 PRINT S1+NO;N;
80 GOSUB 180
90 A$=MID$(I$,4,2)
100 IF LEN(A$)=0 THEN GO TO 150
110 GOSUB 180
120 A$=MID$(I$,6,2)
130 IF LEN(A$)=0 THEN GO TO 150
140 GOSUB 180
150 PRINT
160 GO TO 40
170 REM THIS SUBROUTINE PUTS PROGRAM STEPS INTO MEMORY
180 B$=LEFT$(A$,1)
190 IF B$="0" THEN GO TO 230
200 B=VAL(B$)
210 IF B<>0 THEN GO TO 230
220 B=ASC(B$)-55
230 C$=RIGHT$(A$,1)
240 IF C$="0" THEN GO TO 280
250 C=VAL(C$)
260 IF C<>0 THEN GO TO 280
270 C=ASC(C$)-55
280 D=B*16+C
290 POKE S1+NO,D
300 S1=S1+1
310 PRINT D;
320 B=0
330 C=0
340 RETURN
350 REM THIS PART OF PROGRAM INSERTS BRANCH OFFSETS IN MEMORY
360 A1=0
370 RESTORE
380 K1=0:I1=I1+1
390 M1=0
400 K1=K1+1
410 FOR J=A1 TO 200
420 READ N,I$,J$
430 IF N=0 THEN GO TO 790
440 FOR S=2 TO 6 STEP 2
450 IF LEN(MID$(I$,S,2))=0 THEN GO TO 470
```

More

Address correspondence to Jonathan M. Kraushaar, 7093 Leewood Forest Drive, Springfield, VA 22151.

display with an optional printer capability and Basic editing features. This makes it competitive for performing the functions of the earlier processor kits.

Of course manual entry of machine instructions into the Color Computer is even more tedious than using the microprocessor kits. The desired machine instructions are first expressed in their hexadecimal equivalents, and then the hexadecimal codes are converted into their decimal equivalents and individually poked into memory locations, because the Basic poke command uses the decimal equivalent of each memory location. The proper offsets must also be calculated for branching commands in the machine-language program. Manually editing a program is especially tedious, since new offsets must be calculated and program bytes must be shifted to make room for added steps.

Machine language is needed
to speed execution,
to perform specialized tasks
or to design controllers
and peripheral devices.

The Basic program avoids the problems normally encountered in manual machine-code entry and lets you use the Radio Shack Color Computer to prepare and run machine-code programs.

The program is entered and followed by data lines containing the hexadecimal code for the machine instructions to be executed. These data lines can easily be edited and listed using the same techniques used to edit a Basic program. The Basic program is then run, and the machine-language program is transferred to memory starting at the designated memory location.

To execute the machine-language program on the Color Computer simply enter the command EXEC followed by the decimal equivalent of the memory location where the machine program resides. When executed on the same computer, the machine-language program should be treated as a subroutine with a return from subroutine command (RTS) at the end. After execution, command is returned to the keyboard.

If you want to edit the machine-language program, just edit the data lines, rerun the Basic program and re-execute the machine program by retyping EXEC followed by the memory location of the machine program. The Basic program could be stored on a cassette, with or without the data constituting the machine program. I have used a continuous one-minute cassette tape to facilitate editing, since old versions of the program are sequentially replaced by later ones when the data portion (machine code) of the program is edited and saved. (This avoids rewinding of the recorder or finding the proper tape location.)

Basic line no.	Machine-language program line no.	Machine-language program step (hexadecimal)			Symbolic representation of machine command (not to be included in program when run) (Courtesy of Motorola)
1000	DATA 1,	CC 0400,	(half the length of data		LDD IMM
1010	DATA 2,	10,	block to be moved)		LDY EXT
1020	DATA 3,	BE 0FF0,			
1030	DATA 4,	FE 0FF2,			LDU EXT
1040	DATA 5,	4C,			INC A
1050	DATA 6,	AE A1,			LDX Y+ +
1060	DATA 7,	AF C1,			STX U+ +
1070	DATA 8,	5A,			DEC B
1080	DATA 9,	26 F9,	6	(Machine-language	BNE
1090	DATA 10,	4A		program line no. of	DEC A
1100	DATA 11,	26 F6,	6	branch)	BNE
1110	DATA 12,	39,			RTS
1120	DATA,, (designation for last program step)				

The machine-code program represented above as data and prepared in this form is inserted immediately after the Basic program. Be sure that a single space is inserted between the op code and operand of each machine instruction, (e.g., CC 0400 in line 1000). Other spacing is not critical. Also note that op codes with more than two hexadecimal characters must be arranged as two machine steps (see lines 1010–1020).

The next step is to run the Basic program which first inquires where the machine-code program is to be located in memory. Care should be taken to avoid locating the machine program where the Basic program and data already exist or in memory locations used by your machine. The Radio Shack Color Computer with 4K of memory uses memory locations 1024 to 1536 for the video screen. Basic programs are stored starting at memory location 1537. In the example using the Radio Shack Color Computer, the machine program can be stored starting at memory location 3600. Be sure to check the memory map of the machine you are using. Memory can be reserved where necessary in many machines, using the CLEAR command.

This sample 6809 machine program, once entered, can move a block of stored data in memory. Location 0FF0 and 0FF1 (or 4080 and 81) should contain the two start address bytes of the block to be moved, and location 0FF2 and 0FF3 (or 4082 and 83) should contain the two destination address bytes. A poke command can be used to insert these.

The following is an example in which the initial address of a block of stored data is moved from memory location 3600 to 1280. Memory location 3600 can be represented as the 16th byte after the 14th 256-byte block. Similarly, memory location 1280 can be represented as the 0 byte after the 5th 256-byte block. Therefore, 14 would be poked in location 4080, 16 would be poked in location 4081, 5 would be poked in location 4082 and 0 would be poked in location 4083. Finally, the machine program is executed. On the Radio Shack 4K Color Computer this would be accomplished by typing EXEC 3600.

Note that memory location 1280 is in the middle of the video screen on the Radio Shack 4K Color Computer. This permits immediate visualization of the characters corresponding to the contents of 128 memory locations, 3600 to 3728, when the machine program is executed. In this example you will see a copy of the machine program transferred to screen in the form of an alphanumeric or graphics character for each memory location of the stored program. On p. 120 of the March 1981 *Byte* is a table relating the characters which appear to the memory contents.

Table. Entering the Basic program and data lines. (Courtesy of Motorola.)

To illustrate an application of this program, I have included a short 6809 machine-code program (see table) that can be executed directly on the Radio Shack Color Computer or other 6809 processor system. This program transfers a block of memory to a desired set of addresses. You can rapidly move any block of memory from location A to location B by poking to four memory locations that store the start addresses of the memory block before and after execution.

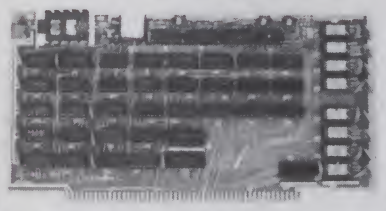
An annotated version of this machine-language program is given in the form of data lines that would be included with the Basic program for entry into memory. When the Basic program is executed, the addresses and data for the loaded machine-language program are displayed.

This program does not enable symbolic instruction entry (the program must be in hexadecimal code to start with to operate in a 4K-byte system), but it does simplify entry and editing of machine-language programs. It also suggests the possibility of developing customized EPROMs for use in other microprocessor-based controllers/devices.■

Listing continued.

```
460 M1=M1+1
470 NEXT S
480 IF LEN(J$)<>0 THEN GO TO 520
490 IF EOF(0)=-1 THEN GO TO 790
500 NEXT J
510 GO TO 790
520 J1=VAL(J$)
530 N1=N
540 A1=J
550 IF K1<>I1 THEN GO TO 400
560 GOSUB 610
570 PRINT M1+NO-1;N1;M
580 POKE M1+NO-1,M
590 GO TO 370
600 REM THIS ROUTINE FINDS LINE BRANCHED TO AND COUNTS STEPS
 BETWEEN THEM
610 M=0
620 RESTORE
630 READ N,I$,J$
640 IF EOF(0)=-1 THEN GO TO 780
650 IF N=J1 THEN GO TO 680
660 IF N=N1 THEN GO TO 680
670 GO TO 630
680 FOR S=2 TO 6 STEP 2
690 A=LEN(MID$(I$,S,2))
700 IF A<>0 THEN M=M+1
710 NEXT S
720 READ N,I$,J$
730 IF N=N1 THEN GO TO 760
740 IF N=J1 THEN GO TO 770
750 GO TO 680
760 M=256-M
770 M=M-2
780 RETURN
790 END
```


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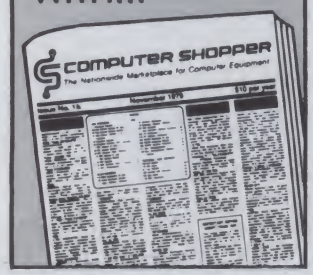
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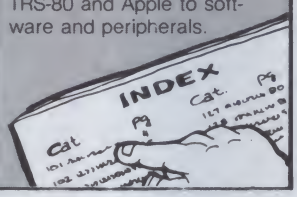
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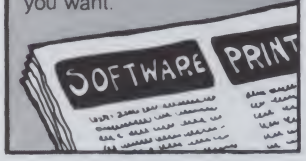
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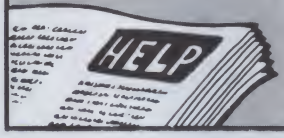
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If you've been thinking about breaking away from Basic and hopping aboard the Pascal bandwagon, here are some timing comparisons that should interest you.

Basic and Pascal Square Off

By John Sommer

Should I give up my old friend Basic and switch to this new language called Pascal? Numerous articles describe it as *the* next language and an introduction to the new Department of Defense language, Ada.

Niklaus Wirth designed Pascal as a teaching tool in 1968. He incorporated valuable features from other languages, especially Algol.

While there are many versions of Pascal, the language has not been officially defined. Probably the most popular version is UCSD (University of California at San Diego) Pascal, which is being used mostly by industrial and personal microcomputer users. The Pascal User's Group (headquartered at the University of Minnesota) is pushing for the British Standards Institute (BSI) version, which is spearheaded by A. M. Addyman of the University of Manchester. The third most popular version is Standard Pascal, which is described in the Jensen and Wirth book *Pascal User Manual and Report.*

Pascal came out of the computer-science classrooms where little interest was expressed for business-oriented I/O. Only in extensions of the language, such as the UCSD version, do you find any real I/O capability.

Most versions of Pascal are compilers which do not produce code that executes directly, but which generate a pseudo code referred to as P-code. This code is then loaded and interpreted by the computer as run-time function.

So why go to this highly typed and structured programming language? Microcomputer users claim *speed.* So I decided to find out how fast the P-code runs as compared to Basic.

In 1977 *Microcomputing* ran several articles on the benchmarking of Basic. The June issue offered "Basic Timing Comparisons" by Tom Rugg and Phil Feldman (p. 66); the revised and updated "Basic Timing Comparisons" appeared in October (p. 20). A variety of microcomputers were evaluated using the then current dialects of Basic. A series of seven benchmark programs of increasing time demands on the pro-

Listing 1.

BENCHMARK 1

BASIC

```
300 PRINT "START"
400 FOR K=1 TO 1000
500 NEXT K
700 PRINT "END"
800 END
```

PASCAL

```
PROGRAM ONE;
VAR K: INTEGER;
BEGIN
    WRITELN('START');
    FOR K:=1 TO 10000 DO;
    WRITELN('END');
END.
```

BENCHMARK 2

```
300 PRINT "START"
400 K=0
500 K=K+1
600 IF K<1000 THEN 500
700 PRINT "END"
800 END
```

```
PROGRAM TWO;
(*$G+*)
LABEL 1;
VAR K:REAL;
BEGIN
    WRITELN('START');
    K:=0;
    1:
        K:=K+1;
        IF K<10000 THEN GOTO 1;
    WRITELN('END');
END.
```

BENCHMARK 3

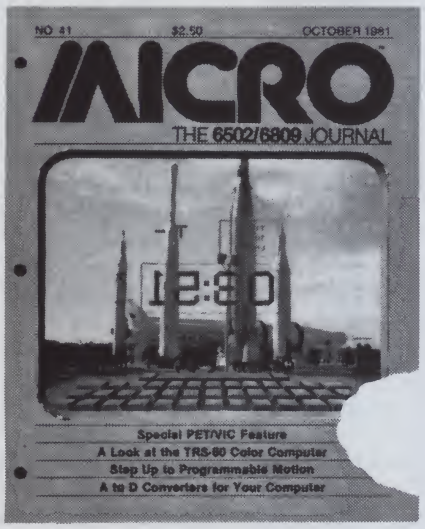
```
300 PRINT "START"
400 K=0
500 K=K+1
510 A=K/K*K+K-K
600 IF K<1000 THEN 500
700 PRINT "END"
800 END
```

```
PROGRAM THREE;
(*$G+*)
LABEL 1;
VAR A,K:REAL;
BEGIN
    WRITELN('START');
    K:=0;
    1:
        K:=K+1;
        A:=K/K*K+K-K;
        IF K<10000 THEN GOTO 1;
    WRITELN('END');
END.
```

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John Sommer (816 Burnt Mills Avenue, Silver Spring, MD 20901) is the microcomputer advisor and coordinator for an agency of the Department of Defense. He is also president of SEI and a computer consultant for small businesses.

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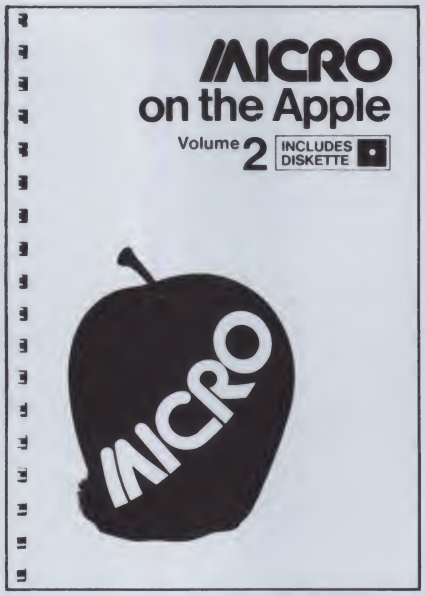
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Listing 1 continued.

```
                        BENCHMARK  4

300 PRINT "START"           PROGRAM FOUR;
400 K=0                     (*$G+*)
500 K=K+1                   LABEL 1;
510 A=K/2*3+4-5             VAR A,K:REAL;
600 IF K<1000 THEN 500      BEGIN
700 PRINT "END"                 WRITELN('START');
800 END                         K:=0;
                                1:
                                    K:=K+1;
                                    A:=K/2*3+4-5;
                                    IF K<10000 THEN GOTO 1;
                                WRITELN('END');
                            END.


                        BENCHMARK  5

300 PRINT "START"           PROGRAM FIVE;
400 K=0                     (*$G+*)
500 K=K+1                   LABEL 1;
510 A=K/2*3+4-5             VAR A,K:REAL;
520 GOSUB 820               PROCEDURE NOTHING;
600 IF K<1000 THEN 500          BEGIN
700 PRINT "END"                 END;
800 END                     BEGIN
820 RETURN                      WRITELN('START');
                                K:=0;
                                1:
                                    K:=K+1;
                                    A:=K/2*3+4-5;
                                    NOTHING;
                                    IF K<10000 THEN GOTO 1;
                                WRITELN('END');
                            END.


                        BENCHMARK  6

300 PRINT "START"           PROGRAM SIX
400 K=0                     (*$G+*)
430 DIM M(5)                LABEL 1;
500 K=K+1                   VAR A,K:REAL;
510 A=K/2*3+4-5                 L:INTEGER;
520 GOSUB 820                   M:ARRAY{1..5} OF REAL;
530 FOR L=1 TO 5            PROCEDURE NOTHING;
540 NEXT L                      BEGIN
600 IF K<1000 THEN 500          END;
700 PRINT "END"             BEGIN
800 END                         WRITELN('START');
820 RETURN                      K:=0;
                                1:
                                    K:=K+1;
                                    A:=K/2*3+4-5;
                                    NOTHING;
                                    FOR L:1 TO 5 DO;
                                    IF K<10000 THEN GOTO 1;
                                WRITELN('END');
                            END.

                        BENCHMARK  7

300 PRINT "START"           PROGRAM SEVEN;
400 K=0                     (*$G+*)
430 DIM M(5)                LABEL 1;
500 K=K+1                   VAR A,K:REAL;
510 A=K/2*3+4-5                 L:INTEGER;
520 GOSUB 820                   M:ARRAY{1..5} OF REAL;
530 FOR L=1 TO 5            BEGIN
535 M(L)=A                      WRITELN('START');
540 NEXT L                      K:=0;
600 IF K<1000 THEN 500          1:
700 PRINT "END"                     K:=K+1;
800 END                             A:K/2*3+4-5;
820 RETURN                          FOR L:=1 TO 5 DO
                                        M{L}:=A;
                                    IF K<10000 THEN GOTO 1;
                                WRITELN('END');
                            END.
```

cessors were used.

How would a variety of computers do with a similar set of benchmark programs written in Pascal? It took very little encouragement to get Apple II owner Bill Laslo to go back to the October 1977 article and recode the seven programs as closely as possible in Pascal. Listing 1 shows the original Basic benchmark programs and their companion Pascal versions. Note that the Pascal loops are ten times longer to make timing easier.

In recent years many dialects of Basic have appeared. Probably the most popular to run under CP/M was CBasic, and then CBasic2. Another recent entry is the Microsoft Basic compiler which has an instruction set very similar to the excellent Microsoft Basic interpreter. To update the 1977 timing list I benchmarked these using a standard Processor Technology SOL-20 (8080 based) with CP/M 1.4.

The Pascal benchmarks were run on a number of systems, ranging from the TRS-80 Model I and Apple II to the big mainframe systems. The results of the tests are shown in Table 1. If you go back to the October 1977 article, be sure to multiply the results by ten for proper comparison. In actuality, I cranked in even longer loops for the mainframe machines so I could capture meaningful times. I picked out two of the systems from the original article and presented those results along with the more recent data—the system with the fastest time (the OSI 8K Basic) and one that represents the middle of the better systems of that era (the Altair Disk Extended Basic, using an 8080 microcomputer).

(I would like to thank my colleagues Dr. Terry Ireland, John Nolan, Drew Pastor, John Epstein, Dave Neuman and Bill Laslo for their help in getting these timed runs.)

One of the more interesting implementations is the DEC PDP 11 series using the UNIX Operating system. With this system, the Pascal program can be developed with the interpreter; then, when it runs smoothly, it can be compiled for some really fast run times.

With the more affordable systems, the UCSD Pascal available on the Apple II and the TRS-80 had comparable times. (The MetaTech Pascal for the TRS-80 which runs under CP/M was not tested, since it does not support the GOTO statement. If your applications can live with this and other limi-

tations of the MetaTech Pascal, it should provide some very fast execution since it generates object code, not the intermediate P-Code runs in the slower interpreter mode—of most microcomputer Pascal versions.

The times for the TI 9900 Development System (not listed since I did not run all of the benchmark tests) indicates a considerable speedup achieved by Texas Instruments, but at the expense of reducing transportability of their code.

We can do a lot with our microcomputers that the big systems can't do much better, but they sure do it quickly! I knew that CBasic2 was slow, but I still can't believe this pseudo-compiled code taking over three times as long as other Basic systems. Quite a convincing argument for using machine subroutines whenever possible with CBasic2.

Where does that leave us? Pascal is unquestionably a better academic language than Basic and for this reason should continue to grow in popularity. But for those of us who have been spoiled by the ease of writing and debugging Basic programs and the performance of Microsoft's Compiled Basic, the motive for change is not so great.■

Benchmark Tests

	1	2	3	4	5	6	7
OSI 8K BASIC	9.0	46.0	82.0	93.0	100.0	148.0	216.0
Altair Disk BASIC	19.0	75.0	206.0	209.0	221.0	369.0	585.0
Microsoft BASIC	20.0	66.0	191.0	188.0	202.0	360.0	566.0
Microsoft Compiled BASIC	11.2	11.3	77.6	40.0	36.0	94.0	275.0
CBASIC2	85.0	153.6	584.0	972.0	942.0	1594.0	1870.0
UNIX Pascal (Interpreted)	.6	2.5	5.4	5.0	5.6	5.9	12.2
UNIX Pascal (Compiled)	.1	.4	.8	.8	.9	1.0	1.4
UNIVAC 1100 Pascal	.06	.32	.60	.74	1.12	1.48	2.37
DEC 10 Pascal	.05	.28	.4	.83	.88	.97	1.08
CDC 7600 Pascal	.005	.015	.032	.045	.102	.125	.100
Apple UCSD Pascal	6.0	26.0	98.0	105.0	120.0	156.0	231.0
TRS-80 UCSD Pascal	7.2	29.0	105.0	121.0	127.0	173.0	223.0

Table 1. Benchmark results. Times are given in seconds.

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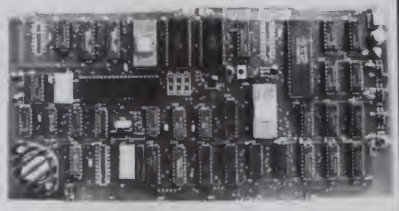
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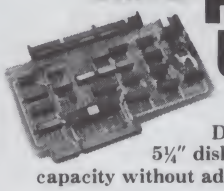
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```
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  NEXT J
NEXT I
```

(answer on p. 152)

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The author takes a hard look at some reasons computers haven't realized their full potential in schools.

Why Johnny Can't Compute

By Art Botterell

Educators are excited about microcomputers now. But when the first flush of enthusiasm passes, they're going to take a long hard look at the strengths and weaknesses of this new technology. There *are* weaknesses—some minor, some critical—with which we must cope if the microcomputer is to avoid the dusty fate of so many earlier "teaching machines."

These problems can't be overcome by enthusiasm alone. They are fundamental structural issues which must be approached coolly and deliberately, before the majority of educators—who want results, not promises—turn away from computers disenchanted.

Institutional Biases

American education evolved before the microcomputer, and many of its methods are now deeply ingrained. Some of these established practices conflict with the nature of the computer as an instructional medium.

For one thing, the microcomputer is an *individualized* medium, and the history of individualization in the mainstream of American education is not a happy one. Despite lip service paid the concept, very little truly individual instruction goes on in most of our schools. This is because of the excessive student-to-teacher ratios imposed by economics, particularly in the public school systems. Research suggests that once the student/teacher ratio exceeds about ten- or 12-to-one, it becomes hard, if not impossible, to attend to the individual needs of students.

To cope, our schools lump groups of students together into classes, and then treat each class as a unit. Teachers strive, under the banners of "enrichment" and "remediation," to keep their students' performance levels clustered tightly around the mean. Advanced students get "activities" to keep them occupied while the teacher helps other students "catch up." Students who vary too much from the norms are removed to "special" classes.

Efforts to individualize teaching run into the argument (valid, as far as it goes) that such techniques create classroom management problems. In fact, the history of instructional technology shows that systems which have prospered—those that include such tools as film, slides and overhead projectors—are typically used in a class of 30 or so students. Other electronic tools, like videotape, instructional TV, and the earlier teaching machines, are only effective with smaller groups, which means that the class must be broken up. Systems which can't be used with the entire class tend to wind up covered with dust in some closet or visual-aids locker.

Any attempt to individualize instruction must deal with this managerial issue first, or be doomed. This is the logic behind computer-managed instruction (CMI).

Another problem is the way we evaluate education—with numbers. Test scores, percentile rankings, absenteeism rates and budgets are the measuring rods of educational quality. But we don't yet know how to measure some kinds of learning numerically. Simulation, one of the most exciting uses of the instructional computer, is a wonderful way to develop an intuitive grasp of processes too complex to deal with analytically. But precisely because it is so sophisticated, such learning is often viewed as less "significant" than other, simpler forms which show up on standardized tests.

There are also problems having to do with the anxieties of teachers and administrators. Some educators worry about the dehumanization of education. Others fear for the future of older skills like reading and multiplication, when competing with television, calculators and computers. Many simply feel inadequate in their grasp of new techniques, and prefer to stick with the methods they know.

Art Botterell (2677 E. Main St., #3, Columbus, OH 43209) is Director of Educational Services of the MicroAge Computer Store in Columbus.

Generally speaking, education in America is not terribly well-funded. Some schools have money for experimentation and growth, but many are hard-pressed to provide buildings and books, let alone computers. Sadly, the schools most needful of the effectiveness and efficiency of microcomputers are usually the ones least likely to get them. With reduced federal spending, the grant programs which have paid for many schools' micros may soon dry up.

And finally, there is the "back to basics" movement. While this philosophy has had limited impact in most schools (mainly because there's little agreement as to what the basics really are), it has made many administrators cautious about introducing anything that might be seen as a frill. More than one school superintendent in the past lost his job at least partly because of a backlash against the new math.

Hardware

But not all the problems are with the institutions. Some spring from the design of the current crop of microcomputers.

Today's micros are generally scale models of the large computers of the past, with a single central processor, keyboard input, CRT or printer output and programming languages borrowed from the mainframes and minis. This suggests an assumption that the form of a computer is independent of its size, which is like arguing that a station wagon should be designed like a tractor-trailer rig.

In fact, the flexibility of the general-purpose programmable microcomputer is one of its greatest liabilities, because flexibility costs money. Schools are asked to pay for multipurpose computers for what are often single-purpose applications. Despite the tremendous drop in the cost of hardware in the past decade, there is still little chance for schools to buy a computer for each student, or even for *each hundred* students. Most in-school microcomputers now support (theoretically) the needs of several hundred students.

Educators try to pare down this absurdly high student/computer ratio by restricting access to the machine to some part of the student body—for example, a computer class, a gifted students program or a special ed program. For the microcomputer to become an important part of the general instructional system, it will have to drop in price by another factor of 10 or 100.

This will happen mostly by eliminating unneeded features—once we learn which ones those are. Because of their flexibility, today's microcomputers provide ideal "test beds" for developing new instructional methods. Once we know what works and what doesn't, we can implement the successful techniques in smaller, less-expensive units for general use. The ultimate educational computers will probably be more like Texas Instruments' Speak & Spell than like the current micros.

A critical issue for instructional technologists in the near future is the role and impact of various input and output systems. The typewriter-style keyboard is difficult for very young students, for students with some kinds of disabilities and for purposes like simulation of driving, flying or other activities which use nontextual control systems. Likewise, visual output by CRT or printer must sometimes yield to speech and music synthesis, and perhaps even eventually to systems using touch, smell or taste.

Another issue is mobility, or the lack of it. Several companies in the U.S. and in Japan are working on portable terminals the size of textbooks, using liquid-crystal displays. Perhaps we will see the clay and wax tablets carried by the students of antiquity returning in electronic form.

As I have already pointed out, one of the concerns about instructional computers is that they do not provide for social interaction among students. Group learning is a very important process, both in terms of instruction and of socialization. We need instructional microcomputer systems which can be shared.

Software

It's a commonplace in this field that the lack of good software is the biggest barrier to the growth of educational computing. As a result, educational institutions and users are hard at work developing instructional programs for the major microcomputers. The problem today is not the quantity of software, nor its availability, but rather its quality. There is a great deal of bad educational software on the market today.

One reason is that developing good instructional materials requires three different kinds of skills. First, technical expertise is needed, to identify ways the computer can teach. Next, instructional design skills are required, to ensure that the potential of the micro is used effectively and to

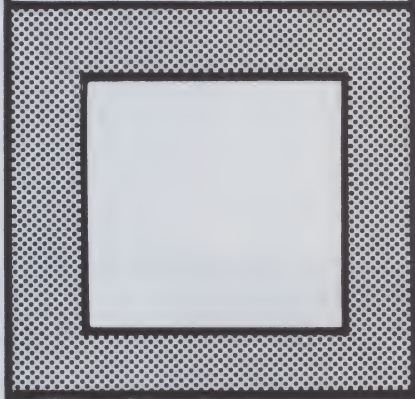
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provide a workable interface between computerized instruction and the rest of the educational program. Finally, expert knowledge of the subject matter is an obvious necessity.

Most instructional software today is accurate enough in its content. But much of it is deficient either technically or in instructional design. Software written by programmers tends to be technically sophisticated but instructionally defective. Software developed by teachers tends to be educationally valid, but weak in its use of the computer's potential.

Rarely does one person have all three sets of skills. Well-rounded courseware is usually the result of cooperation between specialists in each critical area. This poses a problem in organizational design and recruitment which few software suppliers have solved.

Another flaw of most existing instructional software is its lack of scope and sequence. Most educational software on the market addresses one narrow set of learnings in a rifle-shot approach. Thus, the instructor must assemble a computerized curriculum piecemeal. It's as though there were no text for the course, but only a library full of individual chapters and sections, each separately bound.

Individual teachers are not in a position to undertake a project the size of a complete microcomputer-based instructional sequence, any more than they can create textbooks single-handedly. A number of universities have received funds to develop instructional software, but so far much of their work has been either too advanced, or sometimes too rudimentary, to improve the present situation.

The natural candidates for courseware development are the existing commercial publishers and materials developers. But in the past few years many of the major firms have looked at this field and backed away. Why? Mostly because of the cost of software development, which is very large, and worse, very unpredictable. Programming is a skilled-labor-intensive task, and the productivity of programmers varies widely. A lot of research and testing is needed to find the best methods to use in this new medium, and once the software exists, it must be tested, and revised and tested again, and perhaps revised once more.

Publishers are accustomed to considerable returns on their assets. Most of them have been unwilling to spend limited resources to develop products of indeterminate cost and untested marketability, when they know they can make a dependable profit in print. That is why, although many publishers have announced ventures in software development, little of this software has actually come to the market.

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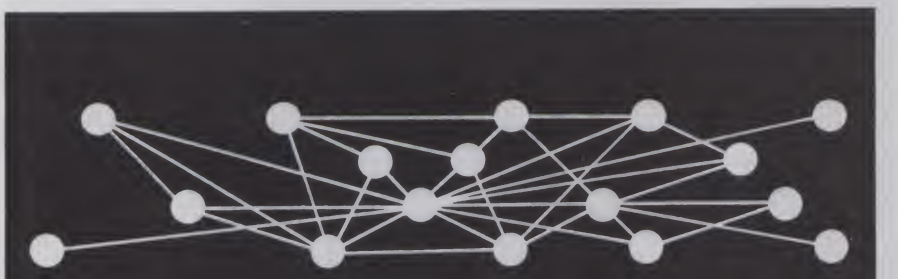
Microcomputers have had early and impressive success penetrating education in the area called computer literacy. In this field the microcomputer is used as a piece of lab equipment, on which students undertake projects designed to teach them about computers. The reasons for this success bear examining.

For one thing, making computer literacy part of the curriculum (usually in the math program) provides a chance for teachers to become computer literate themselves. Judging from the boom in attendance at educational computing fairs and seminars, this is a need felt by many educators. Also, many schools already have some sort of course about computers, so that introducing the microcomputer does little to disrupt the status quo.

Another beauty of computer literacy is that it doesn't require any software. Usually the students develop their own programs. Since most schools spend their whole microcomputing budget on hardware, and since the current software environment is deficient in many areas, computer literacy sometimes becomes the main justification for investing in a micro. Many schools have bought a computer planning to use it for computer-assisted instruction, then settled for teaching computer literacy until they find money and software to pursue their original plans.

Computer literacy also avoids (to some extent) the problems posed by a high student/computer ratio. Since the computer is a piece of lab gear instead of a primary means of instruction, the time each student needs with the machine can be considerably reduced. Thus, with careful scheduling, many more students can use what is usually the only microcomputer in the school.

But although parents and educators agree that today's students should—indeed, *must*—be taught about computers, there is disagreement as to *what* they should be taught.



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One point of view is that the microcomputer should be used to demonstrate and simulate the operation of larger computers. Another approach teaches microcomputer programming as the state of the art. Still another holds that progress will soon render current technologies and techniques obsolete, and that only the relatively timeless concepts of information science are durable enough to be profitably taught.

Regardless, computer literacy has provided an important foot in the door for microcomputers in our schools.

The Prospects

The single most important development in educational microcomputing so far has been the introduction of computer-managed instruction (CMI). CMI turns over to the computer the painstaking and time-consuming tasks of individualization which overwhelm teachers in today's classrooms.

For example, in an ideal school Johnny's teacher might notice that he has trouble with certain multiplication problems. This ideal teacher would give Johnny a diagnostic test to find which elements of these problems are giving him trouble. Then the teacher could suggest that Johnny read a section of a textbook, or view a filmstrip, or run an instructional program on the microcomputer. After Johnny completed the learning units, the teacher would retest him, and if the problem remained, the teacher would try different approaches to teaching the missing skills.

Since most teachers don't have time for such detailed individual analysis and recordkeeping, it makes sense to use a computer. CMI is no newcomer to instructional computing, but on microcomputers it's still in the early stages. Science Research Associates (an IBM-owned educational materials publisher) has released CMI packages for Apple and Atari micros for instruction in mathematics which give diagnostic tests directly to the student at the keyboard. Evans Newton, Inc., of Phoenix has gone a step further with its Project BASIC system, which can be used in any subject with user-specified objectives and learning resources.

Project BASIC uses a batch-mode approach, in which students respond to test items on pencil-marked cards which are fed into the computer through a mark-sense card reader. Since the time-consuming testing process occurs off-line, a single micro can support the needs of an entire school. (Evans Newton recently agreed with Holt, Rinehart and Winston, a CBS-owned textbook publisher, to market a version of Project BASIC already configured for use with the firm's new elementary math texts.)

As I've suggested, some sort of computer management of instruction seems necessary before there can be general acceptance of computerized education. Indeed, CMI might be the key to the long-sought ideal of truly individualized instruction for the majority of America's schoolchildren.

Some believe that the most significant thing about the educational computer is the impact it has on the way children think. The leader in this field is probably Seymour Papert of MIT, whose work with the Logo programming language suggests that the computer can have a profound effect on learning about learning. Since Papert's work lies close to the already booming field of computer literacy (although it is by no means the same thing), we may see it bearing fruit in our schools in the near future.

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systems which now dominate educational applications will continue to be important, especially in remedial and special education, and in subjects like law and medicine where large amounts of rote learning are required. But we must take care to avoid "shakespeare-izing" computers. Many of today's adults suffered a joyless, forced-march introduction to Shakespeare, and some never fully recovered. We must not turn the microcomputer into a tool of oppression in our children's eyes, lest the next generation resent and fear computers because of childhood memories, instead of because of today's occasional multimillion dollar electric bill and impersonal "personalized" form letter.

Naturally, still newer technologies will shape the role of educational computing. The microcomputer-controlled intelligent videodisk is today the darling of instructional technologists. While the videodisk will offer a tremendous improvement of the graphic and audio capabilities of today's micros, it is not yet clear that it will do anything basically different.

But as a digital data-storage medium the optical disk could have far-reaching impact. Because tremendous amounts of data can be packed onto each disk, it may soon be practical to have a complete copy of the catalogue of the Library of Congress on-line in every school library. The videodisk might be the storage breakthrough we need to make the microcomputer truly valuable to the school librarian.

Data communication is another area of tremendous technological growth. The uses of existing "information utilities" like CompuServe and The Source are limited on one hand by the costs of terminal equipment and on the other by the limited data-transmission rate possible over dial-up phone lines, but new approaches like teletext and coaxial (cable TV) data links could open new realms of application in the next few years.

Finally, it's worthwhile to consider the effect that these new methods could have on our educational system. Just as schools today are an expression of the needs and techniques of their history, so microcomputers, if they become a significant part of our education, can be expected to leave their mark. A few observations illustrate some kinds of change we can expect:

- Control Data Corporation, unsuccessful for many years in marketing its highly-developed but expensive PLATO instructional system to the educational establishment, has moved outside the system to create its own CDC Learning Centers.
- A substantial portion of the existing market for instructional software is the "at-home" sector, where the programs are being used to enhance the learning of both children and adults.
- In an effort to bolster productivity, corporations are taking increased responsibility for the education, both basic and continuing, of their employees; many of these firms are turning to computers.
- The military (long a major user of instructional technology) no longer stresses adventure in its recruitment ads; the emphasis now is on educational opportunities.

Clearly, the American educational system is becoming more multifaceted than ever before. Microcomputers, in some ways the most American of learning technologies, can make a valuable contribution, if proper attention is paid to the realities of our schools.■

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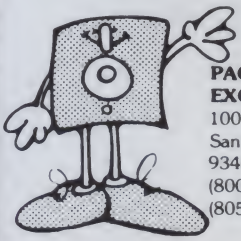
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(from page 145)

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I = 60 → J = 360, 300, 240, . . . , 60 = 6
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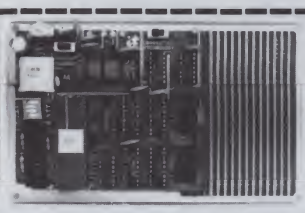
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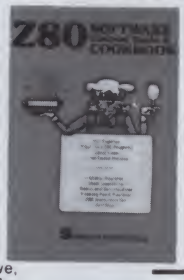
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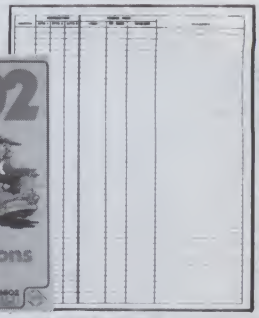
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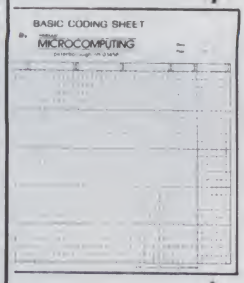
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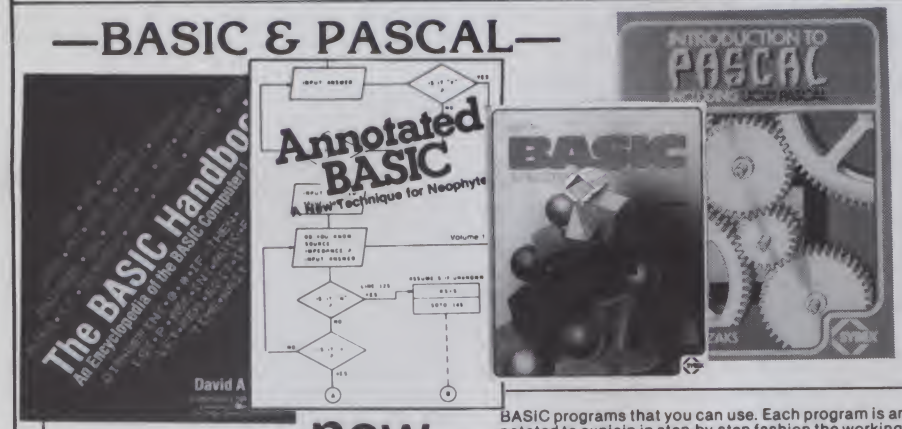
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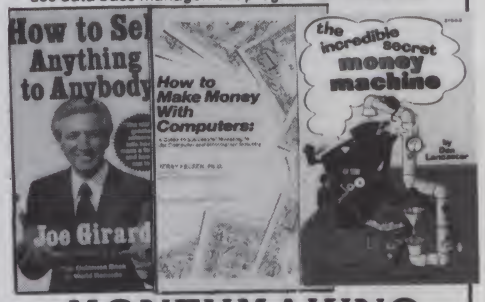
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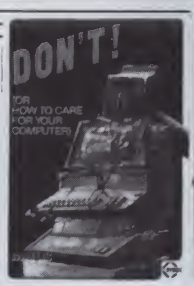
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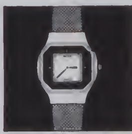
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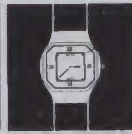
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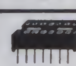


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2,000	10	2.95	13,000	10	2.95	50,000	20	7.95
2,250	100	3.95	14,000	13	2.95	52,000	20	5.95
2,300	33	2.95	14,000	35	3.95	55,000	15	5.95
2,500	15	2.95	19,000	10	3.95	58,000	20	5.95
3,000	25	1.95	20,000	20	2.95	65,000	10	7.95
3,600	40	3.95	20,000	55	3.95	73,000	5	7.95
4,500	50	3.95	21,000	15	3.95	80,000	15	8.95
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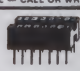
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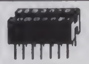
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8 pin LP	.17	.16	.15
14 pin LP	.20	.19	.18
16 pin LP	.22	.21	.20
18 pin LP	.29	.28	.27
20 pin LP	.34	.32	.30
22 pin LP	.37	.36	.35
24 pin LP	.38	.37	.36
28 pin LP	.45	.44	.43
36 pin LP	.60	.59	.58
40 pin LP	.63	.62	.61

SOLDERTAIL STANDARD (TIN)



	1-24	25-49	50-100
14 pin ST	.27	.25	.24
16 pin ST	.30	.27	.25
18 pin ST	.35	.32	.30
24 pin ST	.49	.45	.42
28 pin ST	.99	.90	.81
36 pin ST	1.39	1.26	1.15
40 pin ST	1.59	1.45	1.30

SOLDERTAIL (GOLD) STANDARD



	1-24	25-49	50-100
8 pin SG	.39	.35	.31
14 pin SG	.49	.45	.41
16 pin SG	.54	.49	.44
18 pin SG	.59	.53	.48
24 pin SG	.79	.75	.69
28 pin SG	1.10	1.00	.90
36 pin SG	1.65	1.40	1.26
40 pin SG	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3



	1-24	25-49	50-100
8 pin WW	.59	.54	.49
10 pin WW	.69	.63	.58
14 pin WW	.79	.73	.67
16 pin WW	.85	.77	.70
18 pin WW	.99	.90	.81
20 pin WW	1.19	1.08	.99
22 pin WW	1.49	1.35	1.23
24 pin WW	1.39	1.26	1.14
28 pin WW	1.69	1.53	1.38
36 pin WW	2.19	1.99	1.79
40 pin WW	2.29	2.09	1.89

1/4 WATT RESISTOR ASSORTMENTS – 5%

ASST. 1	5ea.	10 Ohm 27 Ohm	12 Ohm 33 Ohm	15 Ohm 39 Ohm	18 Ohm 47 Ohm	22 Ohm 56 Ohm	50pcs.	$1.95
ASST. 2	5ea.	68 Ohm 180 Ohm	82 Ohm 220 Ohm	100 Ohm 270 Ohm	120 Ohm 330 Ohm	150 Ohm 390 Ohm	50pcs.	$1.95
ASST. 3	5ea.	470 Ohm 1.2K	560 Ohm 1.5K	680 Ohm 1.8K	820 Ohm 2.2K	1K 2.7K	50pcs.	$1.95
ASST. 4	5ea.	3.3K 8.2K	3.9K 10K	4.7K 12K	5.6K 15K	6.8K 18K	50pcs.	$1.95
ASST. 5	5ea.	22K 56K	27K 68K	33K 82K	39K 100K	47K 120K	50pcs.	$1.95
ASST. 6	5ea.	150K 390K	180K 470K	220K 560K	270K 680K	330K 820K	50pcs.	$1.95
ASST. 7	5ea.	1M 2.7M	1.2M 3.3M	1.5M 3.9M	1.8M 4.7M	2.2M 5.6M	50pcs.	$1.95
ASST. 8R		Includes Resistor Assts. 1-7 (350 pcs.)						$10.95 ea.

$10.00 Minimum Order — U.S. Funds Only
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4/82

INTERSIL

Part No.	Function	Price
7045IPI	CMOS Precision Timer	14.95
7045EV/Kit*	Stopwatch Chip, XTL	24.95
7106CPL	3½ Digit A/D (LCD Drive)	16.95
7106EV/Kit*	IC, Circuit Board, Display	34.95
7107CPL	3½ Digit A/D (LED Drive)	15.95
7107EV/Kit*	IC, Circuit Board, Display	29.95
7116CPL	3½ Digit A/D LCD Dis. HLD.	18.95
7117CPL	3½ Digit A/D LED Dis. HLD.	17.95
7201IDR	Low Battery Volt Indicator	2.25
7205IPG	CMOS LED Stopwatch/Timer	12.95
7205EV/Kit*	Stopwatch Chip, XTL	19.95
7206CJPE	Tone Generator	5.15
7206CEV/Kit*	Tone Generator Chip, XTL	12.95
7207AIPD	Oscillator Controller	6.50
7207AEV/Kit*	Freq. Counter Chip, XTL	13.95
7208IPI	Seven Decade Counter	17.95
7209IPA	Clock Generator	3.95
7215IPG	4 Func. CMOS Stopwatch CKT	13.95
7215EV/Kit*	4 Func. Stopwatch Chip, XTL	19.95
7216AIJI	8-Digit Univ. Counter C.A.	32.00
7216CIJI	8-Digit Freq. Counter C.A.	26.95
7216DIPI	8-Digit Freq. Counter C.C.	21.95
7217IJI	4-Digit LED Up/Down Counter	12.95
7218CIJI	8-Digit Univ. LED Drive	10.95
7224IPL	LCD 4½ Digit Up Counter DRI	11.25
7226AIJL	8-Digit Univ. Counter	31.95
7226AEV/Kit*	5 Function Counter Chip, XTL	74.95
7240IJE	CMOS Bin Prog. Timer/Counter	4.95
7242IJA	CMOS Divide-by-256 RC Timer	2.05
7250IJE	CMOS BCD Prog. Timer/Counter	6.00
7260IJE	CMOS BCD Prog. Timer/Counter	5.25
7555IPA	CMOS 555 Timer (8 pin)	1.45
7556IPD	CMOS 556 Timer (14 pin)	2.20
7611BCPA	CMOS Op Amp Comparator 5MV	2.25
7612BCPA	CMOS Op Amp Ext. Cmvr. 5MV	2.95
7621BCPA	CMOS Dual Op Amp Comp. 5MV	3.95
7631CCPE	CMOS Tri Op Amp Comp. 10MV	5.35
7641CCPD	CMOS Quad Op Amp Comp. 10MV	7.50
7642CCPD	CMOS Quad Op Amp Comp. 10MV	7.50
7660CPA	Voltage Converter	2.95
8038CCPD	Waveform Generator	4.95
8048CCPE	Monolithic Logarithmic Amp	21.60
8069CCQ	50ppm Band—GAP Volt Ref. Diode	2.50
8211CPA	Volt Ref/Indicator	2.95
8212CPA	Volt Ref/Indicator	2.95

74C

74C00	.39			74C221	1.95
74C02	.39	74C95	1.59	74C240	2.25
74C04	.39	74C107	1.89	74C244	2.25
74C08	.39	74C151	2.95	74C373	2.49
74C10	.39	74C154	3.95	74C374	2.59
74C14	.75	74C157	2.25	74C901	.69
74C20	.39	74C160	1.69	74C903	.69
74C30	.39	74C161	1.60	74C911	10.95
74C42	1.39	74C162	1.49	74C912	10.95
74C48	1.95	74C163	1.69	74C915	1.69
74C73	.79	74C164	1.59	74C917	10.95
74C74	.79	74C173	1.39	74C922	5.49
74C85	1.95	74C174	1.39	74C923	5.75
74C86	.99	74C175	1.19	74C925	7.50
74C89	6.95	74C192	1.69	74C926	7.50
74C90	1.29	74C193	1.69	80C95	.79
74C93	1.29	74C195	1.59	80C97	.79

LINEAR

LH0002CN	6.85			LM702H	.79
LM10CLH	4.50			LM703CN	.89
LM11CLH	4.75	LM340T-5	1.25	LM709N	.29
LH0070-OH	4.95	LM340T-12	1.25	LM710N	.79
TL071CP	.79	LM340T-15	1.25	LM711N	.79
TL072CP	1.39	LM341P-5	.75	LM723N	.69
TL074CN	2.49	LM341P-12	.75	LM733N	1.00
LH0082CD	35.80	LM341P-15	.75	LM739N	1.19
TL082CP	1.19	LM342P-5	.69	LM741CN	.35
TL084CN	2.19	LM342P-12	.69	MC1741SCG	3.00
LH0094CD	36.80	LM342P-15	.69	LM747N	.79
LM300H	.99	LM348N	1.25	LM748N	.59
LM301CN	.35	LM350K	5.75	LM1014N	2.75
LM302H	1.95	LF351N	.60	LM1310N	1.95
LM304H	1.95	LF353N	1.00	LM1458CN	.59
LM305H	.99	LF355N	1.10	LM1488N	1.25
LM307CN	.45	LF356N	1.10	LM1489N	1.25
LM308CN	1.00	LM358N	1.00	LM1496N	1.95
LM309H	1.95	LM359N	1.79	LM1556V	1.75
LM309K	1.25	LM370N	4.49	LM1800N	2.95
LM310CN	1.75	LM373N	3.25	LM1871N	5.49
LM311/CN	.90	LM377N	2.95	LM1872N	5.49
LM312H	2.49	LM380N	1.25	LM1877N-9	3.25
LM317MP	1.15	LM381N	1.95	LM1889N	3.20
LM317T	1.75	LM382N	1.79	LM1896N	1.75
LM317K	3.95	LM384N	1.95	LM2002T	1.49
LM318CN	1.95	LM386N-3	1.29	LM2877P	2.05
LM319N	1.95	LM387N	1.45	LM2878P	2.25
LM320K-5	1.35	LM389N	1.35	LM2896P-1	2.25
LM320K-12	1.35	LM392N	.69	LM3189N	2.95
LM320K-15	1.35	LF398N	4.00	LM3900N	.69
LM320T-5	1.25	LM399H	5.00	LM3905CN	1.25
LM320T-12	1.25	TL494CN	4.49	LM3909N	1.15
LM320T-15	1.25	TL496CP	1.75	LM3914N	3.95
LM323K	5.95	NE510A	6.00	LM3915N	3.95
LM324N	.99	NE529A	4.95	LM3916N	3.95
LM329DZ	.65	NE531H	3.95	RC4136N	1.25
LM331N	3.95	NE536H	6.00	RC4151NB	3.95
LM334Z	1.30	NE540H	6.00	RC4194TK	6.95
LM335Z	1.40	NE544N	4.95	RC4195TK	5.49
LM336Z	1.75	NE550A	1.30	LM4500A	3.25
LM337T	1.95	NE555V	.39	ICL8038B	4.95
LM337MP	1.15	LM556N	.99	LM13080N	1.29
LM338K	6.95	NE564N	3.95	LM13600N	1.49
LM339N	.99	LM565N	1.25	75138N	1.95
LM340K-5	1.35	LM566CN	1.95	75450N	.89
LM340K-12	1.35	LM567V	1.25	75451CN	.39
LM340K-15	1.35	NE570N	4.95	75492	.89

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

Value	1-9	10-99	100+	Value	1-9	10-99	100+
10 pf	.08	.06	.05	.001μF	.08	.06	.05
22 pf	.08	.06	.05	.0047μF	.08	.06	.05
47 pf	.08	.06	.05	.01μF	.08	.06	.05
100 pf	.08	.06	.05	.022μF	.09	.07	.06
220 pf	.08	.06	.05	.047μF	.09	.07	.06
470 pf	.08	.06	.05	.1μF	.15	.12	.10

100 VOLT MYLAR FILM CAPACITORS

.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022mf	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22

+20% DIPPED TANTALUMS (Solid) CAPACITORS

.1/35V	.39	.34	.29	1.5/35V	.41	.37	.29
.15/35V	.39	.34	.29	2.2/35V	.51	.45	.34
.22/35V	.39	.34	.29	3.3/25V	.53	.47	.37
.33/35V	.39	.34	.29	4.7/25V	.63	.56	.45
.47/35V	.39	.34	.29	6.8/25V	.79	.69	.55
.68/35V	.39	.34	.29	15/25V	1.39	1.25	.95
1.0/35V	.39	.34	.29	22/6V	.79	.69	.55

MINI. ALUMINUM ELECTROLYTIC CAPACITORS

Axial	1-99	100-499	500+	Radial	1-99	100-499	500+
.47/50V	.16	.14	.10	.47/25V	.15	.13	.12
1.0/50V	.19	.16	.12	.47/50V	.16	.14	.13
3.3/50V	.17	.15	.11	1.0/16V	.15	.13	.12
4.7/25V	.18	.15	.11	1.0/25V	.16	.14	.13
10/25V	.18	.15	.11	1.0/50V	.17	.15	.14
10/50V	.19	.16	.12	4.7/16V	.15	.13	.12
22/25V	.19	.16	.12	4.7/25V	.16	.14	.13
22/50V	.24	.20	.18	4.7/50V	.17	.15	.14
47/25V	.25	.21	.19	10/16V	.15	.13	.12
47/50V	.29	.25	.23	10/25V	.16	.14	.13
100/25V	.28	.24	.22	10/50V	.17	.15	.14
100/50V	.41	.37	.34	47/50V	.25	.21	.19
220/25V	.39	.34	.33	100/16V	.21	.17	.14
220/50V	.49	.45	.41	100/25V	.25	.23	.21
470/25V	.54	.49	.45	100/50V	.37	.34	.31
1000/16V	.79	.69	.61	220/16V	.25	.21	.19
2200/16V	.89	.79	.69	470/25V	.35	.31	.27



UTIC
MINI STEREO FM RECEIVER WITH HEADPHONES
For Joggers, Cyclists, and Skaters!

FEATURES: Lightweight headphones. Left/right balance control. Full fidelity stereo sound. Additional black soft carrying case & shoulder strap. Belt clip (hands free). Operates on 3 AA cell batteries (not incl.). Compact size: 3⅛" x 4⅛" x 1". Wt. 6 oz.

Model 1810 List Price $89.95 ..... **$29.95**

SPEAKERS



Part # A0201 — 1 — 2-9
2¼" Round — 8 Ohm
.25 Watt (4" Leads)
Size: 2¼" x ¾" — 1.25 — .99



Part # SF-25016 — 1 — 2-9
2½" Square — 16 Ohm
.25 Watt (4 mount. holes)
Large Ceramic Magnet
Size: 2⅝" x 2⅝" x ¾" — 1.39 — 1.25

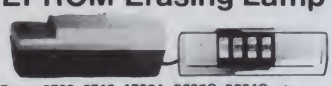


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RAM SALE

STATIC RAMS
MM2114N-2 4K (200NS) ..... **$2.49 each**
(8 EACH $16.95/lot) (100 EACH $195.95/lot)
MM2114N-2L 4K (200NS) Low Power .... **$2.95 each**
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MM2147N 4K (70NS) ..... **$4.95 each**
(8 EACH $34.95/lot) (100 EACH $419.95/lot)
MM6116P-4 16K (200NS) ..... **$14.95 each**
(8 EACH $99.95/lot) (100 EACH $1195.00/lot)

DYNAMIC RAMS
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(8 EACH $99.95/lot) (100 EACH $1195.00/lot)
MM5290N-2 16K (150NS) 4116 ..... **$2.95 each**
(8 EACH $19.95/lot) (100 EACH $225.00/lot)
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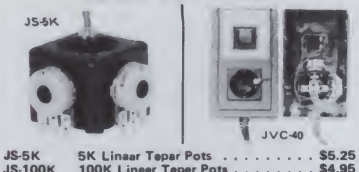
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- Erases 2708, 2716, 1702A, 5203Q, 5204Q, etc.
- Erases up to 4 chips within 20 minutes.
- Maintains constant exposure distance of one inch.
- Special conductive foam liner eliminates static build-up.
- Built-in safety lock to prevent UV exposure.
- Compact — only 7-5/8" x 2-7/8" x 2"
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UVS-11EL Replacement Bulb $16.95
UVS-11E **$79.95**

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JS-100K 100K Lineer Taper Pots $4.95
JVC-40 40K (2) Video Controller in case ... $4.95

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The **dependable, low cost, largest sailing fan for commercial cooling applications.**

- 105cfm free air delivery
- 4.68" sq. x 1.50" depth. Weight - 17 oz.
- acoustical rating as low as NC-38
- more than 10 yrs. cont. duty at 10°C
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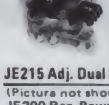
115V, 50/60Hz, 14 Watts, 105cfm — Ultrasonically cleaned & tested.

MU2A1 .... $9.95 ea.

NEW!

JE215 Adjustable Dual Power Supply

General Description: The JE215 is a Dual Power Supply with independent adjustable positive and negative output voltages. A separate adjustment for each of the supplies provides the user unlimited applications for IC current voltage requirements. The supply can also be used as a general all-purpose variable power supply.



FEATURES:
- Adjustable regulated power supplies, pos. and neg. 1.2VDC to 15VDC.
- Power Output (each supply): 5VDC @ 500mA, 10VDC @ 750mA, 12VDC @ 500mA, and 15VDC @ 175mA.
- Two, 3-terminal adj. IC regulators with thermal overload protection.
- Heat sink regulator cooling
- LED "on" indicator
- *Printed Board Construction*
- 120VAC input
- Size: 3-1/2"w x 5-1/16"L x 2"H

JE215 Adj. Dual Power Supply Kit (as shown) .. $24.95
(Picture not shown but similar in construction to above)
JE200 Reg. Power Supply Kit (5VDC, 1 amp) .. $14.95
JE205 Adapter Brd. (to JE200) ±5,±9 & ±12V. $12.95
JE210 Var. Pwr. Sply. Kit, 5-15VDC, to 1.5amp. $19.95

MICROPROCESSOR COMPONENTS

8080A/8080A SUPPORT DEVICES

INS8080A-	CPU	4.95
DP8212	8-Bit Input/Output	3.25
DP8214	Priority Interrupt Control	5.95
DP8216	Bi-Directional Bus Driver	3.49
DP8224	Clock Generator/Driver	3.95
DP8226	Bus Driver	3.49
DP8228	System Controller/Bus Driver	4.95
DP8238	System Controller	5.95
INS8243	I/O Expander for 48 Series	9.95
INS8250	Asynchronous Comm. Element	16.95
DP8251	Prog. Comm. I/O (USART)	6.95
DP8253	Prog. Interval Timer	8.95
DP8255	Prog. Peripheral I/O (PPI)	5.95
DP8257	Prog. DMA Control	9.95
DP8259	Prog. Interrupt Control	9.95
DP8275	Prog. CRT Controller	39.95
DP8279	Prog. Keyboard/Display Interface	9.95
DP8303	System Timing Element	6.95
DP8304	8-Bit Bi-Directional Receiver	3.95
DP8307	8-Bit Bi-Directional Receiver	3.95
DP8308	8-Bit Bi-Directional Receiver	3.95
DP8310	Octal Latched Peripheral Driver	5.25
DP8311	Octal Latched Peripheral Driver	5.25

6800/6800 SUPPORT DEVICES

MC6800	MPU	7.95
MC6802CP	MPU with Clock and RAM	14.95
MC6810API	128x8 Static RAM	4.95
MC6821	Peripheral, Adapt (MC6820)	7.49
MC6828	Priority Interrupt Controller	17.95
MC6830L8	1024x8-Bit RDM (MC68A30-8)	14.95
MC6850	Asynchronous Comm. Adapter	6.95
MC6852	Synchronous Serial Data Adapter	6.95
MC6860	0-600bps Digital MODEM	10.95
MC6862	2400bps Modulator	12.95
MC6880A	Quad 3-State Bus. Trans. (MC8T26)	2.25

MICROPROCESSOR CHIPS

Z80 (780C)	CPU (MK3880N) (2MHz)	11.95
Z80A (780-1)	CPU (MK3880N-4) (4MHz)	13.95
CDP1802	CPU	19.95
2650	MPU	16.95
IDM2901ADC	CPU—4-Bit Slice (Com, Temp. Grade)	19.95
MC56502	MPU w/Clock (6K Bytes Memory)	11.95
INS8036N-6	MPU—8-Bit (6MHz)	7.95
INS8039N-6	CPU—Sgl. Chip 8-Bit (128 bytes RAM)	9.95
INS8040N-6	CPU (256 Bytes RAM)	24.95
INS8070N	CPU—64 Bytes RAM	24.95
INS8073N	CPU w/Basic Micro Interpreter	29.95
P8085	CPU	9.95
TMS9900JL	MPU—16-Bit	39.95
1173AN-1	30 Tune Musical MPU Chip	8.95

SHIFT REGISTERS

MM5006H	Dual 25-Bit Dynamic	.50
MM5031H	Dual 50-Bit Dynamic	.50
MM5006H	Dual 100-Bit Static	.50
MM5010H	Dual 64-Bit Accumulator	.50
MM1402N	256-Bit Dynamic	2.95
MM5013N	1024-Bit Dynamic/Accumulator	1.95
MM5016H	500/512-Bit Dynamic	1.95
MM5034N	Octal 80-Bit	9.95
MM5035N	Octal 80-Bit	9.95
2504V(1404A)	1024-Bit Dynamic	1.95
2518N	Hex 32-Bit Static	3.95
2522V	Dual 132-Bit Static	2.95
2524V	512-Bit Dynamic	.99
2525V	1024-Bit Dynamic	2.95
2527V	Dual 256-Bit Static	2.95
2528V	Dual 200-Bit Static	4.00
2529V	Dual 240-Bit Static	4.00
2532N	Quad 80-Bit Static	2.95
3341PC	Fifo (Dual 80)	6.95

DATA ACQUISITION

AF100-1CN	Universal Active Filter 2.5%	5.95
AF121-1CJ	Touch Tone Low Band Filter	19.95
AF122-1CJ	Touch Tone High Band Filter	19.95
LM308CH	Super Gain Op Amp	1.15
LM334Z	Constant Current Source	1.30
LM335Z	Temperature Transducer	1.40
LF356N	JFET Input Op Amp	1.10
LF398N	Sample & Hold Amplifiers	3.95
LM399H	Temp. Comp. Prec. Ref. (.5ppm/C°)	9.00
ADC0804LCN	8-Bit A/D Converter (1 LSB)	4.95
DAC0806LCN	8-Bit D/A Converter (0.78% Lin.)	2.25

DATA ACQUISITION (CONTINUED)

ADC0809CCN	8-Bit A/D Converter (8-Ch. Multi.)	5.25
ADC0817CCN	8-Bit A/D Converter (16-Ch. Multi.)	10.95
DAC1000LCN	10-Bit D/A Conv. Micro. Comp. (0.05%)	13.95
DAC1008LCN	10-Bit D/A Conv. Micro. Comp. (0.20%)	8.95
DAC1020LCN	10-Bit D/A Converter (0.05% Lin.)	8.49
DAC1020CLCN	10-Bit D/A Converter (0.20% Lin.)	5.95
DAC1222LCN	12-Bit D/A Converter (0.20% Lin.)	9.95
CD4051N	8-Channel Multiplexer	1.19
AY-5-1013	30K BAUD UART	6.95

RAM'S

1101	256x1 Static	1.49
1103	1024x1 Dynamic	.99
2101 (8101)	256x4 Static	3.95
2102	1024x1 Static	1.75
2111.02	1024x1 Static	1.95
2111 (8111)	256x4 Static	3.95
2112	256x4 Static MOS	4.95
2114	1024x4 Static 450ns	2.25
2114L	1024x4 Static 450ns Low Power	2.49
2114-2	1024x4 Static 200ns	2.49
2114L-2	1024x4 Static 200ns Low Power	2.95
745200	256x1 Static	6.95
4116N-4 (UPD416)	16K Dynamic 250ns (MM5290N-4)	1.95
4164N-3	64K Dynamic 200ns	14.95
MM2147N	4096x1 Fast 70ns	4.95
5101	256x4 Static	7.95
MM5261	1024x1 Dynamic Fully Decoded	.99
MM5262	2Kx1 Dynamic	.99
MM5280/2107	4096x1 Dynamic	4.95
MM5290N-2 (4116)	16K Dynamic 150ns (UPD416C-3)	2.95
MM5298J-3A	8K Dyn. Rplcmn (Lower ½ of MM5290J)	1.95
HM6116-4	16K (2Kx8) Static 200ns	14.95
82S25	64 Bit RAM (16x40C)	3.49
UPD414/MK4027	4K Dynamic 16-pin	4.95
TMS4044-45NL	4K Static	9.95
TMS4046	1024x4 Static	9.95

PROMS/EPROMS

1702A	2K UV Erasable PROM	5.95
2708	8K EPROM	2.95
TMS2716	16K EPROM (-5V, +5V, +12V)	9.95
2716 Intel(2516) TI	16K EPROM (Single +5V)	8.95
2732 Intel TI	32K EPROM	17.95
2758	8K EPROM (450ns) (Single +5V)	7.49
2764Q	64K EPROM (Hitachi HN462764)	49.95
5203	2048 PROM	14.95
82S23(74S188)	32x8 PROM (Open Collector)	3.95
82S115	4096 Bipolar PROM	14.95
82S123(74S288)	32x8 Tri-State Bipolar PROM	3.95
82S185	8K PROM	16.95

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ROM'S

2513(2140)	Character Generator (Upper Case)	9.95
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MCM66710P	128x8x7 ASCII Shifted w/Greek	13.50
MCM66740P	128x9x7 Math Symbol & Pictures	13.50
MCM66750P	128x9x7 Alpha. Control Char. Gen.	13.50

MICROPROCESSOR MANUALS

M-Z80	User Manual	7.50
M-CDP1802	User Manual	7.50
M-2650	User Manual	5.00

SPECIAL FUNCTION

DS0025CN	Dual MOS Clock Driver (5MZ)	3.50
DS0026CN	Dual MOS Clock Driver (5MZ)	1.95
INS1771N-1	Floppy Disc Controller	24.95
INS2651N	Communication Chip	19.95
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MM58174N	Microprocessor Compatible Clock	11.95
CDP402N	Microcontroller with 64-Digit RAM and Direct LED Drive	6.95
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CDP470N	32-Seg.VAC Fluor. Driver (20-pin pkg.)	3.25

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AY-5-9200	Repertory Dialer	14.95
AY-5-9500	CMOS Clock Generator	4.95
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HD0165-5	Keyboard Encoder (16 keys)	7.95
74C922	Keyboard Encoder (16 keys)	5.49
74C923	Keyboard Encoder (20 keys)	5.75
MM53190N	Push Button Pulse Dialer	7.95
MM74990N	96/144-Key Serial Keyboard Encoder	8.95

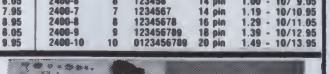


2400-10

EECO Rocker DIP Switch — "Mini-Dip™" 2400 Series
THE MOST UNIQUE DIP SWITCH AVAILABLE!
MINI-DIP is designed to retrofit all major brands of Dip switches. Unique features include locking rod design to prevent accidental actuation and gold self-wiping contact. One-piece housing and press-fit terminals prevent contamination. 2-10 station Form "A" and 1-5 station Form "C".
• Terminals on .100 x .300 (2.54 x 7.62) centers • PCB or dip socket mountable • Positive cleaning/wiping action with gold contact • Total seal and bottom seal

Part No.	Pos.	Configuration	Socket	Price
2400-2	2	12	8 pin	.70 - 10/ 6.95
2400-3	3	123	8 pin	.89 - 10/ 7.95
2400-4	4	1234	8 pin	.99 - 10/ 8.95
2400-ABC0	4	ABC0	8 pin	.99 - 10/ 8.95
2400-5C	6	C54321	14 pin	1.09 - 10/ 9.95
2400-8	8	123456	14 pin	1.09 - 10/ 9.95
2400-7	7	1234567	14 pin	1.19 - 10/10.95
2400-8	8	12345678	16 pin	1.29 - 10/11.95
2400-9	9	123456789	18 pin	1.39 - 10/12.95
2400-10	10	0123456789	20 pin	1.49 - 10/13.95

GRAB BAG SPECIALS



GB180 (Pictured Above)

CAPACITORS

Part No.	Description	Price
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GB101	60 each Mylar	4.00
GB102	60 each Electrolytics	4.00
GB103	40 each Tantalum (tubular & dipped)	4.00
GB176	40 each Dipped Mica (10pf-1000pf @ 100-500V)	4.00

INTEGRATED CIRCUITS

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GB106	30 each Linear - marked (LM301, 307, 741, 308, etc.)	4.00
GB148	30 each Exar - marked (XR320, 1310, 4136, etc.)	4.00
GB150	20 each Shift Registers - marked (2510, 2518, 2502, 2533, etc.)	4.00
GB157	50 each DTL Series - marked (DM830, 932, 936, 946, etc.)	3.00
GB158	5 pcs. Positive Voltage Regulators (TO-3 case) (7805, 06, 12, 15, 18, 24, etc.) Linear marked	4.25
GB159	5 pcs. Negative Voltage Regulators (TO-3 case) (7905, 06, 12, 15, 18, 24, etc.) Linear marked	4.00
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GB182	50 each 7-Segment Displays (various colors and sizes)	5.00

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GB178	500 each 1/4, 1/2, 1 watt (marked/unmarked) resistors	4.00

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GB166	40 asst. toggle, rocker, pushbutton	10.00
GB179	20 each Dip Switches (asst. positions)	8.95

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GB141	200 each Washers and Spacers (nylon and teflon)	2.00
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GB144	200 each Solder lugs (small)	2.00
GB146	100 each Lugs — crimp on (some insulated)	2.00
GB146	100 each Grommets, cord strain reliefs and hole plugs	3.00
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GB162	200 pcs. sheet metal and metal cleaning screws	2.00
GB168	200 pcs. snips bits, chip inserters, etc.	3.00
GB169	100 pcs. tie wraps and Tie wrap clips (3-6")	2.00
GB180	100 pcs. Robot/Slot Car gears, shafts, wheels, motors	8.95

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GB123	30 each Heat Sinks - assorted sizes	$3.00
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GB127	100 each Transistors — plastic and power	3.00
GB128	30 each Toroid Cores — iron and tape	4.00
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GB160	Printed Circuit Board — Contains 50-75 components on each board	2.00
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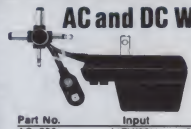
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205610	**Intel Peripheral Design Handbook** Full data sheets, appl. notes for Intel peripheral device components (644 pages)	$7.50

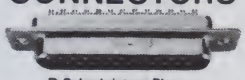
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With Universal Plug and 9V Battery Snap
Selective voltages: 6,9,12VDC. Polarity selection (+/-). six-foot line from adapter to plugs — six-inch line from adapter to battery snap. 120V/60Hz. 300mA.

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DC 800	120V/60Hz	8VDC 400mA (batt. charger)	$2.49
DC6912 (above)	120V/60Hz	6,9,12VDC 300mA	$9.95
DV9200	117V/60Hz	9VDC 200mA	$3.25
DC900	120V/60Hz	9VDC 500mA	$3.95
DC1200	120V/60Hz	12VDC 300mA	$3.95

CONNECTORS



DB25P	D-Subminiatura Plug	$2.95
DB25S	D-Subminiatura Socket	$3.50
D20418-2	Screw Lock Hdwr. (2) DB25S/P	2/$.99
DB51226	Cover for DB25P/S	$1.75
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UG88/U	BNC Plug	$1.79
UG89/U	BNC Jack	$3.79
UG175/U	UHF Adaptar	$ .49
SO239	UHF Penel Recp.	$1.29
PL258	UHF Adaptar	$1.60
PL259	UHF Plug	$1.60
UG260/U	BNC Plug	$1.79
UG1094/U	BNC Bulkhead Recp.	$1.29

TRS-80 16K Conversion Kit
Expand your 4K TRS-80 System to 16K
Kit comes complete with:
- 8 ea. MM5290 (UPD416/4116) 16K Dyn. Ram (*ns)
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TRS-16K2 *150ns 19.95
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KEYBOARDS

Limited Quantity



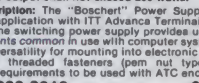
Datanectics 74-Key Keyboard
Uses EA 20134 Chip (Electronic Arrays). Size: 16¾"L x 5½"W x 1-3/8"H. White, black, blue, grey key caps. (No Data Sheet) —
Part No. KB354 ..... $29.95 ea.



Micro Switch 69-Key Keyboard
Uses AMI SW20350K Chip. Size: 16-3/8"L x 5¼"W x 1-5/8"H Metal Frame. Light & dark grey key caps (No Data Sheet)
Part No. KB69SD12-2 ..... $19.95 ea.

Boschert Multi-Voltage Power Supply
5VDC, 12VDC and 24VDC

Limited Quantity



FEATURES: Voltages*: 5VDC @ 25amps, 12VDC @ 4amps, & 24VDC @ 4amps. Reg. Load: +5V out ±1%, +12 & 24V out ±5% (20-100% load). Overvolt. & overcurr. protection. 115 or 230VAC input. Wt. 4 lbs. Size: 4.95" x 2.50" x 15.00"
***Total average output shall not exceed 200 watts.**

General Description: The "Boschert" Power Supply was originally designed for application with ITT Advanca Terminal Controller (ATC). This open frame switching power supply provides user with high current requirements common in use with computer systems. Its compact size provides versatility for mounting into electronic enclosures. Each supply has 6 threaded fasteners (pem nut type) for mounting. Specification requirements to be used with ATC enclosed.
Part No. 200-3010 ..... $69.95 each
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The JE600 Encodar Kayboard Kit provides two separate hexadecimal digits produced from sequential key entries to allow direct programming for 8-bit microprocessor or 8-bit memory circuits. Three additional keys are provided for user operations with one having a bistable output available. The outputs are latched and monitored with 9 LED readouts. Also included is a key entry strobe. Features: Full 8-bit latched output for microprocessor use. Three user-define keys with one being bistable operation. Debounce circuit provided for all 19 keys. 9 LED readouts to verify entries. Easy interfacing with standard 16-pin IC connector. Only +5VDC required for operation. Size: 3½"H x 8¼"W x 8¾"D

JE600/DTE-HK (After assembled as pictured above) **$99.95**
JE600 Kit 19-Key Hexadec. Keyboard, PC Board & Cmpnts. (no case) .. **$59.95**
K19 19-Key Keyboard (Keyboard only) **$14.95**
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7400N	19	LM317K	3 75	CD4018	94	8T28	1 95	AY5-1013	3 95	DA15P	2 10
7402N	19	LM318	1 49	CD4019	45	8T97	99	AY5-1014	6 95	DA15S	3 10
7404N	22	LM320K-5	1 35	CD4020	95	8T98	99	3341	6 95	Complete Set	9 50
7409N	19	LM320K-12	1 35	CD4021	95	**MOS MEMORY RAM**		**PROM**		**Stopwatch Kit**	**26.95**
7410N	19	LM320K-15	1 35	CD4022	1 10	2101-1	1 95	1702A	4 50	**Auto Clock Kit**	**17 95**
7414N	55	LM320T-5	85	CD4023	28	2102-1	85	2532	17 50	**Digital Clock Kit**	**19 75**
7420N	19	LM320T-8	85	CD4024	75	2102AL-4	1 25	2708	2 95	**RESISTORS ¼ watt 5%**	
7430N	19	LM320T-12	85	CD4025	23	2102AN-2L	1 65	2716TI	8 50	10 per type	05
7442N	49	LM320T-15	85	CD4026	1 65	2104A-4	4 95	2716 5 Volt	5 50	100 per type	015
7445N	69	LM323K-5	4 95	CD4027	65	21078 4	3 75	8-2716 5 Volt	39 00	1000 per type	012
7447N	69	LM324N	59	CD4028	80	2111-1	2 99	2732	16 50	5000 per type	0085
7448N	69	LM339N	99	CD4029	95	2112-2	2 99	2758	7 49	350 piece pack	
7474N	35	LM340K-5	1 35	CD4030	45	2114	2 24	8741A	39 95	5 per type	8 95
7475N	49	LM340K-8	1 35	CD4035	85	2114L 300ns	2 50	8748	39 95	½ watt 5% per type	05
7486N	65	LM340K-12	1 35	CD4040	95	2114L 450ns	2 37	8748-8	34 95		
7489N	1 70	LM340K-15	1 35	CD4042	75	4116 200ns	2 50	8755A	49 95	**DIP SWITCHES**	
7490N	35	LM340K-24	1 35	CD4043	85	8-4116 200ns	15 40	N82S23	2 95	4 position	85
7495N	55	LM340T-5	75	CD4044	85	MM5280	3 00	N82S123	3 95	5 position	90
74100N	1 00	LM340T-8	75	CD4046	95	MM5321	9 95	N82S126	5 75	6 position	90
74107N	30	LM340T-12	75	CD4049	45	MM5330	5 94	N82S129	4 75	7 position	95
74123N	55	LM340T-15	75	CD4050	55	P5101L	8 95	N82S131	4 95	8 position	95
74125N	45	LM340T-18	75	CD4051	95	4200A	11 50	N82S136	8 75	**KEYBOARDS**	
74145N	60	LM340T-24	75	CD4060	1 42	9368	3 50	N82S137	8 75	56 key ASCII keyboard kit	$74 95
74150N	1 20	LM350	5 50	CD4066	71	410D	10 00	DM8577	2 90	Fully assembled	84 50
74151N	65	LM377	2 29	CD4068	39	416	2 50	8223	3 50	Enclosure Plastic	19 95
74154N	1 25	LM380N	1 00	CD4069	35	1MM2016	16 95	**CONNECTORS**		Metal Enclosure	69 95
74157N	55	LM381	1 60	CD4070	30	HM6116	16 50	30 pin edge	2 50		
74161N	70	LM382	1 60	CD4071	30			44 pin edge	2 75	**LEDS**	
74162N	85	LM709H	59	CD4072	30			86 pin edge	4 00	Red T018	15
74163N	85	LM723H/N	49	CD4073	35			100 pin edge	3 95	Green Yellow T018	20
74174N	89	LM733N	85	CD4075	30			100 pin edge w/w	4 95	Jumbo Red	25
74175N	85	LM741CH	35	CD4076	95					Green Orange Yellow Jumbo	25
74190N	1 15	LM741N	35	CD4078	30					**Cliplite LED Mounting Clips**	4 80
74192N	79	LM747H/N	75	CD4081	30					(spec red, ambec green yellow clear)	
74193N	79	LM748N	50	CD4082	30					**CONTINENTAL SPECIALTIES in stock**	
74221N	1 25	LM1303N	1 75	CD4116	47					Complete line of breadboard test equip	
74298N	85	LM1304	1 10	CD4490	5 50					**OK WIRE WRAP TOOLS in stock**	
74365N	65	LM1305	1 27	CD4507	99					Complete line of AP Products in stock	
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74367N	65	LM1310	2 75	CD4510	95					**SPECIAL PRODUCTS**	
		LM1458	55	CD4511	94					2 5 MHz Freq Counter Kit	37 50
74LS00 TTL		LM1812	8 25	CD4515	2 25					30 MHz Freq Counter Kit	47 75
74LS00N	25	LM1889	2 49	CD4516	1 10						
74LS02N	25	LM2111	1 75	CD4518	1 25					**AC TRANSFORMERS**	
74LS04N	25	LM2902	2 25	Cu4520	1 02					**FRAME**	**WALL PLUG**
74LS05N	25	LM3900N	59	CD4527	1 51					6V 500 ma $4 00	10V 2 amp $7 95
74LS08N	35	LM3905	1 25	CD4528	1 25					6 3V CT 600 ma 4 60	12V 250 ma 2 95
74LS10N	25	LM3909N	95	CD4553	3 50					12V 250 ma 1 95	12V CT 250 ma 3 75
74LS13N	45	MC1458V	55	CD4566	2 45					12 6V CT 600 ma 4 95	12V 500 ma 4 90
74LS14N	99	NE550N	1 30	CD4583	2 35					12 6V CT 2 amps 5 95	12V 1 amp 5 95
74LS20N	25	NE555V	39	CD4585	95					12 6V CT 4 amp 8 60	12V 2 amp 7 95
74LS22N	25	NE556A	65	CD40192	3 00					12 6V CT 8 amp 10 80	6 9 12 VDC
74LS28N	35	NE565A	1 00	74C00	35					24V CT 100 ma 3 95	300 ma 8 95
74LS30N	25	NE566V	1 50	74C04	35					24V CT 600 ma 4 95	9 VDC 500 ma 3 75
74LS33N	55	NE567V	1 00	74C10	35					**Constant Voltage Transformers** 12V 11 amp	
74LS38N	35	NE570B	4 75	74C14	75					5V 23 amp 24V 11 amp	15 00
74LS74N	45	78L05	60	74C20	35						
74LS75N	50	78L08	60	74C30	35						
74LS90N	60	78M05	85	74C48	1 95						
74LS93N	65	75108	1 49	74C74	85						
74LS95N	85	75491CN	50	74C76	80						
74LS107N	40	75492CN	55	74C90	1 25						
74LS112N	45	75494CN	89	74C93	1 25						
74LS113N	45			74C154	3 25						
74LS132N	75	**A to D CONVERTER**		74C160	1 69						
74LS136N	49	8038B	4 50	74C175	1 19						
74LS151N	75	8700CJ	13 95	74C192	1 65						
74LS155N	79	8701CN	22 00	74C221	1 90						
74LS157N	75	8750CJ	13 95	74C905	6 00						
74LS162N	95	LD130	9 95	74C906	75						
74LS163N	95	9400CJ/V F	7 40	74C914	1 95						
74LS174N	95	ICL7103	9 50	74C922	5 00						
74LS190N	1 00	ICL7107	14 25	74C923	5 50						
74LS221N	1 19			74C925	6 75						
74LS258N	69	**CMOS**		74C926	6 95						
74LS367N	69	CD4000	25	74C927	6 95						
		CD4001	35								
LINEAR		CD4002	35	**INTERFACE**							
CA3045	90	CD4006	95	8095	65						
CA3046	1 10	CD4007	25	8096	65						
CA3081	1 80	CD4008	95	8097	65						
CA3082	1 90	CD4009	45	8098	65						
CA3089	3 40	CD4010	45	8T09	1 25						
LM301AN-AH	34	CD4011	35	8T10	1 75						
LM305H	87	CD4012	25	8T13	1 40						
LM307N	35	CD4013	45	8120	4 95						
LM308N	98	CD4014	95	8123	1 75						
LM309K	1 25	CD4015	95	8124	1 75						
LM311H/N	64	CD4016	45	8125	3 20						

IC SOCKETS					
Solder Tin	**Low Profile**				
PIN	**1UP**	**PIN**	**1UP**		
8	13	22	30		
14	14	24	30		
16	16	28	40		
18	20	36	58		
20	29	40	49		
WIRE WRAP LEVEL 3					
PIN		**PIN**			
14	55	24	93		
16	57	28	1 00		
18	67	40	1 59		
2 level 14 pin w/w			20		
CRYSTALS					
1 MHz			4 50		
2 MHz			3 95		
4 MHz			3 95		
5 MHz			3 95		
10 MHz			3 95		
18 MHz			3 90		
20 MHz			3 90		
32 MHz			3 90		
32768 Hz			4 00		
1 8432 MHz			4 50		
3 5795 MHz			1 20		
2 0100 MHz			1 95		
2 097152 MHz			3 95		
2 4576 MHz			3 95		
3 2768 MHz			3 95		
5 0688 MHz			3 95		
5 185 MHz			3 95		
5 7143 MHz			3 95		
6 5536 MHz			3 95		
14 31818 MHz			3 95		
18 432 MHz			3 95		
22 1184 MHz			3 95		
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74C923			5 50		
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DB25P			2 95		
DB25S			3 50		
Cover			1 25		
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Model 950					$980 00

4116 200ns Dynamic RAM 8/$15.40

1981 IC MASTER CLOSEOUT $59.95



RCA Cosmac 1802 Super Elf Computer $106.95

The Super Elf is a small single board computer that does many **big** things. It's an excellent computer for training and for learning programming with its machine language and yet it's easily **expanded** with **additional memory, Full Basic, ASCII Keyboards, video character generation, etc.**

ROM monitor; State and Mode displays; Single step; Optional address displays; Power Supply; Audio Amplifier and Speaker; Fully socketed for all IC's; Full documentation.

The **Super Elf** includes a **ROM** monitor for program loading, editing and execution with **SINGLE STEP for program debugging** which is not included in others at the same price. With **SINGLE STEP** you can see the microprocessor chip operating with the **unique Quest** address and data bus displays **before, during** and **after** executing instructions. Also, CPU mode and instruction cycle are decoded and displayed on 8 LED indicators.

An RCA 1861 **video graphics** chip allows you to connect to your own TV with an inexpensive video modulator to do graphics and games. There is a **speaker system** included for writing your own music or using many music programs already written. The speaker amplifier may also be used to drive relays for control purposes.

A 24 key **HEX keyboard** includes 16 HEX keys plus **load, reset, run, wait, input, memory protect, monitor select** and **single step**. Large, on board displays provide output and optional **high and low address**. There is a 44 pin standard connector slot for PC cards and a 50 pin connector slot for the Quest Super Expansion Board. Power supply and sockets for **all** IC's are included plus a detailed 127 pg. instruction manual which now includes over 40 pgs. of software info, including a series of lessons to help get you started and a music program and graphics target game. Many schools and universities are using the Super Elf as a course of study. OEM's use it for training and R&D.

Remember, other computers only offer Super Elf features at additional cost or not at all. **Compare before you buy. Super Elf Kit $106.95, High address option $8.95, Low address option $9.95. Custom Cabinet** with drilled and labelled plexiglass front panel **$24.95.** All metal Expansion Cabinet, painted and silk screened, with room for 5S-100 boards and power supply **$57.00. NiCad Battery Memory Saver Kit $6.95.** All kits and options also completely assembled and tested.

Questdata, a software publication for 1802 computer users is available by subscription for $12.00 per 12 issues. Single issues $1.50. Issues 1-12 bound $16.50.

Moews Video Graphics **$3.50,** Games and Music **$3.00,** Chip 8 Interpreter **$5.50,** Starship 4K cassette **$14.95.** Exciting and challenging space game. Complete manual included.

Free 14 page brochure
of complete Super Elf system.

Quest Super Basic V5.0

A new enhanced version of **Super Basic** now available. Quest was the first company worldwide to ship a full size Basic for 1802 Systems. A complete function **Super Basic** by **Ron Cenker** including floating point capability with scientific notation (number range $\pm 1.7E^{38}$), 32 bit integer ± 2 billion; multi dim arrays, string arrays; string manipulation; cassette I/O; save and load, basic, data and machine language programs; and over 75 statements, functions and operations.

New improved faster version including **renumber** and essentially **unlimited variables.** Also, an exclusive user expandable command library.

Serial and Parallel I/O routines included

Super Basic on Cassette $55.00.

Super Expansion Board with Cassette Interface $89.95

This is truly an astounding value! This board has been designed to allow **you** to decide how you want it optioned. **The Super Expansion Board comes with 4K of low power RAM** fully addressable anywhere in 64K with built-in memory protect and a **cassette interface**. Provisions have been made for all other options on the same board and it fits neatly into the hardwood cabinet alongside the **Super Elf**. The board includes slots for up to 6K of **EPROM** (2708, 2758, 2716 or TI 2716) and is **fully socketed.** EPROM can be used for the monitor and Tiny Basic or other purposes.

A 1K Super ROM Monitor $19.95 is available as an on board option in 2708 EPROM which has been preprogrammed with a program loader/editor and error checking multi file cassette read/write software, (relocatable cassette file) another exclusive from Quest. It includes register save and readout, block move capability and video graphics driver with blinking cursor. Break points can be used with the register save feature to isolate program bugs quickly, then follow with single step. If you have the **Super Expansion Board** and **Super Monitor** the monitor is up and running at the push of a button.

Other on board options include **Parallel Input and Output Ports** with **full handshake**. They allow easy connection of an ASCII keyboard to the input port. **RS 232 and 20 ma Current Loop** for teletype or other device are on board and if you need more memory there are two **S-100** slots for static RAM or video boards. Also a 1K Super Monitor version 2 with video driver for full capability display with Tiny Basic and a video interface board. **Parallel I/O Ports $9.85, RS 232 $4.50, TTY 20 ma I/F $1.95, S-100 $4.50.** A **50 pin connector set** with ribbon cable is available at **$18.95** for easy connection between the **Super Elf** and the **Super Expansion Board.**

Power Supply Kit for the complete system (see Multi-volt Power Supply below).

Rockwell AIM 65 Computer

6502 based single board with full ASCII keyboard and 20 column thermal printer 20 char alphanumeric display ROM monitor.. fully expandable **$419.00.** 4K version **$449.00** 4K Assembler **$35.00**, 8K Basic Interpreter **$65.00**

Special small power supply 5V 2A 24V .5A assem in frame **$59.00.** Molded plastic enclosure to fit both AIM 65 and power supply **$52.50.** AIM 65 1K in cabinet with power supply, switch, fuse, cord assem. **$559.00.** 4K **$579.00. A65/40-5000 AIM 65/40 w/16K RAM and monitor $1295.00.** RAM Board Kit (16K, **$195**) (32K, **$215**) VD640 Video Interface Kit **$119.00.** A&T **$149.00.** Complete AIM 65 in thin briefcase with power supply **$518.00.** Special Package Price 4K AIM, 8K Basic, power supply, cabinet **$629.00**

AIM 65/KIM/SYM/Super Elf 44 pin expansion board, board with 3 connectors **$22.95.**



Super Color S-100 Video Kit $129.95

Expandable to 256 x 192 high resolution color graphics. 6847 with all display modes computer controlled. Memory mapped 1K RAM expandable to 6K. S-100 bus 1802, 8080, 8085, Z80, etc. **Dealers: Send for excellent pricing/margin program.**

ELECTRONIC SYSTEMS KITS

Apple Peripheral Kits

SERIAL I/O INTERFACE 0 to 30,000 baud, D.T.R., Input & output from monitor or basic, or use Apple as intelligent terminal, Bd only (P/N 2) **$14.95,** Kit (P/N 2A) **$51.25,** Assembled (P/N 2C) **$62.95.**

PROTOTYPING BOARD (P/N 7907) **$21.95.**

PARALLEL TRIAC OUTPUT BOARD 8 triacs, each can switch 110V, 6A loads, Bd only (P/N 210) **$19.20,** Kit (P/N 210A) **$119.55.**

OPTO-ISOLATED INPUT BOARD 8 inputs, can be driven from TTL logic, Bd only (P/N 120) **$15.65,** Kit (P/N 120A) **$69.95.**

Interface Kits

SERIAL/PARALLEL INTERFACE Bidirectional, Baud rates from 110 to 19.2K, sw selectable polarity of input and output strobe, 5 to 8 data bits, 1 or 2 stop bits, parity odd or even or none, all characters contain a start bit, +5 & −12V required.Bd only (P/N 101) **$11.95,** Kit (P/N 101A) **$42.89.**

RS-232/TTL INTERFACE Bidirectional, requires ±12V, Kit (P/N 232A) **$9.95.**

RS-232/20mA INTERFACE Bidirectional, 2 passive opto-isolated circuits, Kit (P/N 7901A) **$14.95.**

PROM Eraser

Will erase 25 PROMs in 15 minutes. Ultraviolet, assembled. 25 PROM capacity **$37.50** (with timer **$69.50**). 6 PROM capacity OSHA/UL version **$78.50** (with timer **$108.50**).

NiCad Battery Fixer/Charger Kit

Opens shorted cells that won't hold a charge and then charges them up, all in one kit w/full parts and instructions. No PC board. **$8.95**

Z80 Microcomputer

16 bit I/O, 2 MHz clock, 2K RAM, ROM Breadboard space. Excellent for control. Bare Board **$28.50.** Full Kit **$99.00.** Monitor **$20.00.** Power Supply Kit **$35.00.** Tiny Basic **$30.00.**

Modem Kit $60.00

State of the art, orig., answer. No tuning necessary. 103 compatible 300 baud. Inexpensive acoustic coupler plans included. Bd. only $17.00. Article in June *Radio Electronics*.

60 Hz Crystal Time Base Kit $4.40

Converts digital clocks from AC line frequency to crystal time base. Outstanding accuracy.

Video Modulator Kit $9.95

Convert TV set into a high quality monitor w/o affecting usage. Comp. kit w/full instruc.

Multi-volt Computer Power Supply

8v 5 amp, ±18v .5 amp, 5v 1.5 amp, −5v .5 amp, 12v .5 amp, −12v option. ±5v, ±12v are regulated. Basic Kit **$35.95.** Kit with chassis and all hardware **$51.95.** Add $5.00 shipping. Kit of hardware **$16.00.** Woodgrain case **$10.00.** $1 50 shipping.

Type-N-Talk by Votrax

Text to speech synthesizer with unlimited vocabulary, built-in text to speech algorithm, 70 to 100 bits per second speech synthesizer, RS232C interface **$359.00.** Speech IC **$79.95.**

1802 16K Dynamic RAM Kit $149.00

Expandable to 64K. Hidden refresh w/clocks up to 4 MHz w/no wait states. Addl. 16K RAM **$25.00.**

S-100 4-slot expansion $ 9.95
Super Monitor VI.I Source Listing $15.00

Elf II Adapter Kit $24.95

Plugs into Elf II providing Super Elf 44 and 50 pin plus S-100 bus expansion. (With Super Expansion). High and low address displays, state and mode LED's optional **$18.00.**

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4K x 1 STATIC 18 PIN CERAMIC
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CD4013	.29	CD4511	.60
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CD4023	.20	74C903	.20
CD4042	.60		

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4KX1 22 Pin 1.59
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PRIORITY ONE ELECTRONICS

S-100 CPU



CPU-Z - GODBOUT

2/4 MHZ Z80 CPU 24 Bit Addressing

WOW!

PART NO.	DESCRIPTION		LIST PRICE	OUR PRICE
KDGBT 160A	A & T		$295.00	$199.00
KDGBT 160C	CSC	3-6 MHZ.	$395.00	$375.00

DUAL PROCESSOR 8085-8088 - GODBOUT

6 or 8 MZ Provides true 16 Bit Power with a standard 8 bit S-100 bus.

KDGBT 1612A	A & T	6 MHZ.	$425.00	$399.00
KDGBT 1612C	CSC	6/8 MHZ	$525.00	$498.00

SOLID STATE DISK DRIVE, 3500% FASTER!

Not Really, But the Next Best Thing For Godbout 8085/88 Users. Call for Details on M-Drive. See Page 340 of November **BYTE**

KDGBT MD 128K		$1,550.00
KDGBT MD 256K		$3,000.00

2810 Z80 CPU-CA. COMP. SYST.

2/4 MHZ Z80A CPU with RS232C Serial I/O Port complete with Monitor PROM for 2422 Disk Controller

KDCCS 2810A	A & T		$350.00	$260.00

CB2 Z80 CPU - S.S.M.

2/4 MHZ will accept 2716, or 2732, or RAM RUN/STOP and single step switches

KOSSMCB2K	Kit			$260.00
KOSSMCB2A	A & T		$344.00	$310.00
KOSSMZ80M	SSMZ80 Monitor			$80.00

CBIA 8080 CPU - S.S.M.

8080 CPU, 1K RAM, Holds 1 2708, 1 Bit parallel input port.

KOSSMC81K	Kit			$163.00
KOSSMCB1A	A & T		$252.00	$225.00
KOSSM6080M	SM 8080 Monitor			$50.00

S-100 I/O BOARDS

SYSTEM SUPPORT 1 - GODBOUT

Serial port (software prog baud), 4K EPROM OR RAM provision, 15 levels of interrupt, real time clock, optional math processor

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KDGBT162A	Assembled & Tested	$399.00	$360.00
KDGBT162C	CSC	$495.00	$460.00
KDGBT8231	Math Chip		$195.00
KDGBT8232	Math Chip		$195.00
KDGBT162AM1	A&T with 8231 Math Chip		$555.00
KDGBT162CM1	CSC with 8231 Math Chip		$655.00
KDGBT162AM2	A&T with 8232 Math Chip		$555.00
KDGBT162CM2	CSC with 8232 Math Chip		$655.00

MPX CHANNEL BOARD - GODBOUT

I/O Multiplexer, using 8085A-2 CPU on board

	With 4K RAM		
KDGBT166A4	A & T	$495.00	$445.00
KDGBT166C4	CSC	$595.00	$535.00
	With 16K RAM		
KDGBT166A16	A & T	$649.00	$585.00
KDGBT166C16	CSC	$749.00	$675.00

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Two Serial I/O

KDGBT133A	A & T	$249.00	$219.00
KDGBT133C	CSC	$324.00	$296.00

INTERFACER II - GODBOUT

Three parallel, one serial I/O board

KDGBT150A	A & T	$249.00	$219.00
KDGBT150C	CSC	$324.00	$289.00

INTERFACER III - GODBOUT

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KDGBT1748A	A & T	$699.00	$629.00
KDGBT1748C	CSC 200 hr. Burn In	$849.00	$750.00

INTERFACER 3 WITH 5 SERIAL PORTS

KDGBT1745A	A & T	$599.00	$559.00
KDGBT1745C	CSC 200 hr. Burn In	$699.00	$629.00

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Three Serial, Two parallel

KDMDSMB32DD	A & T	$359.00	$329.00

SWITCHBOARD - MORROW DESIGNS

Two serial I/O, four parallel I/O, one status port, one strobe port

KDMDSSB2411		$299.00	$269.00

I/O4 - SSM

Two serial I/O, two parallel I/O

KDSSMID4K	Kit		$210.00
KDSSMID4A	A & T	$290.00	$260.00

I/O 5 - SSM

2 Serial, 3 Parallel including 1 Centronics

KDSSMID5I	A & T	$329.00	$300.00

I/O 8 - SSM

8 Port Serial I/O with Timer

KDSSMI08A	A & T	$550.00	$495.00

2710 4 PORT SERIAL - CCS

4 Full handshaking RS232 ports and optional 2K ROM

KDCCS2710D1	A & T	$360.00	$310.00

2719 2 SERIAL & 2 PARALLEL - CCS

2 RS232 C ports, 2 8 bit parallel ports, & optional 2K ROM

KDCCS2719D1	A & T	$360.00	$325.00

2720 4 PORT PARALLEL - CCS

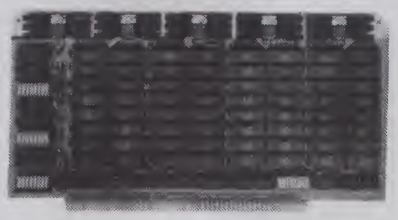
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KDCCS2720D1	A & T	$250.00	$225.00

S-100 10 MHZ STATIC RAM

NEW LOW PRICES!

RAM 20 - 32K
SALE $299.00



32K STATIC RAM - GODBOUT

RAM 20 10 MHZ, 4K byte block disable, bank select or 24 bit addressing available 8, 16, 24 or 32K

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KDGBT164AC8	8K CSC	$280.00	$260.00
KDGBT164AA16	16K A&T	$285.00	$260.00
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KDGBT164AA24	24K A&T	$355.00	$325.00
KDGBT164AC24	24K CSC	$425.00	$395.00
KDGBT164AA32	32K A&T	$425.00	$299.00
KDGBT164AC32	32K CSC	$495.00	$450.00

CMOS STATIC RAM

For a complete analysis of the advantages of CMOS memory, see the "Product Description" on page 416 of the January Issue of **BYTE.**

64K CMOS STATIC RAM - GODBOUT

RAM 17, 10 MHZ, 2 Watt, DMA Compatable 24 Bit Addressing

KDGBT175A48	48K A&T	$650.00	$619.00
KDGBT175C48	48K CSC 200hr.	$750.00	$710.00
KDGBT175A64	64K A&T	$795.00	$755.00
KDGBT175C64	64K CSC 200hr	$895.00	$850.00

NEW! 32K x 16 BIT CMOS STATIC RAM - GODBOUT

RAM 16 10 MHZ, 32K x 16 or 64K x 8 IEEE/696 16 BIT 2 Watt, 24 Bit Addressing

KDGBT160A	64K A&T	$895.00	$850.00
KDGBT160C	64K CSC	$995.00	$945.00

NEW! 128K NMOS STATIC RAM - GODBOUT

RAM 21 10MHZ 128K X 8 OR 64K x 16 IEEE/696 8 or 16 Bit 1.2 Amps 24 Bit Addressing

KDGBT187A	128K A&T	$1695.00	$1610.00
KDGBT167C	128K CSC	$1895.00	$1795.00

S-100 PROM

PBI PROM PROGRAMMER - SSM

Programs 2708 or 2716's, operates as a 4K/8K EPROM BOARD AS WELL.

KDSSMP61K	Kit		$170.00
KDSSMPB1A	A & T	$265.00	$220.00

ECONOROM 2708 - GODBOUT

16K x 8 EPROM Board using 2708, Power on jump to any 256 byte

KDGBT125A	A & T	$135.00	$120.00
KDGBT125C	CSC	$195.00	$175.00

MB8A - SSM

1K/16K 2708 EPROM board, disable in 1K increments

KDSSMMB6AK	Kit		$114.00
KDSSMMB6AA	A & T	$179.00	$150.00

S-100 VIDEO BOARDS

SPECTRUM - GODBOUT

Color Graphics board with Parallel I/O

KDGBT144A	A & T	$399.00	$349.00
KDGBT144C	CSC	$449.00	$399.00
KDGBT20	Sublogic Universal Graphics Interpreter Software		$35.00

VB - 3 S.S.M.

80 x 25 or 50 character video display Memory Mapped, Parallel Keyboard port

KDSSMVB3K24	80 x 24 Kit		$425.00
KOSSMVB3A24	80 x 24 A&T	$499.00	$440.00
KDSSMVB3UP	80 x 50 Line Upgrade		$ 30.00

VB2-S.S.M.

I/O Mapped Video Board, with Parallel Keyboard port 64 x 16

KDSSMVB2K	Kit		$190.00
KDSSMVB2A	A & T	$269.00	$229.00

VBBB - S.S.M

Memory Mapped Video Board 64 x 16 character display or 64 x 16 graphics display

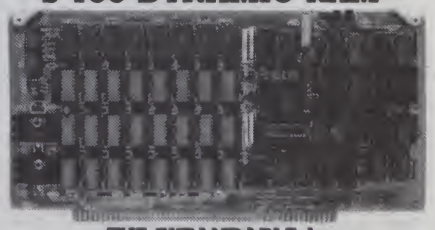
KDSSMVB1K	Kit		$179.00
KDSSMVB1A	A & T	$242.00	$220.00

S-100 MOTHERBOARDS - GODBOUT

Active termination, 6-12-20 slot

KDGBT153A	A&T 6 slot, 2 lbs.	$140.00	$126.00
KDGBT153C	CSC 6 slot, 2 lbs.	$190.00	$175.00
KDGBT154A	A&T 12 slot, 3 lbs.	$175.00	$155.00
KDGBT154C	CSC 12 slot, 3 lbs.	$240.00	$220.00
KDGBT155A	A&T 20 slot, 4 lbs.	$265.00	$235.00
KDGTB155C	CSC 20 slot, 4 lbs.	$340.00	$310.00

S-100 DYNAMIC RAM



THE EXPANDABLE 1

PRIORITY 1 ELECTRONICS

THE EXPANDABLE 1™ 64K Dynamic Ram board provides your S-100 system with 64K of reliable, high-speed dynamic RAM. Compatable with most of the major S-100 systems on the market, including those with front panels, it supports DMA operations and requires no Wait states with current microprocessors.

- *User expandable from 16 to 64K*
- *Supports DMA*
- *Designed to IEEE proposed S-100 bus standards*
- *2 or 4 MHz operation*
- *Operates with either an 8080 or Z-80 based S-100 system, providing processor-transparent refreshes with both*
- *Supports IMSAI-type front panels*
- *Jumper-selectable Phantom input*
- *Uses Popular 4116 RAMS*
- *All ICs in sockets*
- *Any 16K block can be made bank-independent*
- *Fully buffered address and data lines*
- *Fail-safe refresh circuitry for extended Wait states*
- *Board configuration with reliable, easy-to-configure Berg jumpers*

KOPRIEXP116	16K Assembled & Tested	$299.00
KOPRIEXP132	32K Assembled & Tested	$339.00
KDPRIEXP148	48K Assembled & Tested	$379.00
KDPRIEXP164	64K Assembled & Tested	$409.00

S-100 DISK CONTROLLERS

2422A - CA. COMP. SYST.

I/O Mapped, controls 8", single or double density A&T with CPM 2.2 8" S.D.

		LIST PRICE	OUR PRICE
KDCCS2422A		$475.00	$375.00

DISK JOCKEY 2D - MORROW

Memory Mapped, controls 8", single or double density, serial I/O

KDMDIDJ2206	A&T with CP/M 2.2	$399.00	$375.00

S-100 DISK SUBSYSTEMS

DJ2B DISCUS SINGLE SIDED MORROW

8" DBL Density drives with cabinet, power supply controller, with CP/M 2.2 and Microsoft Basic

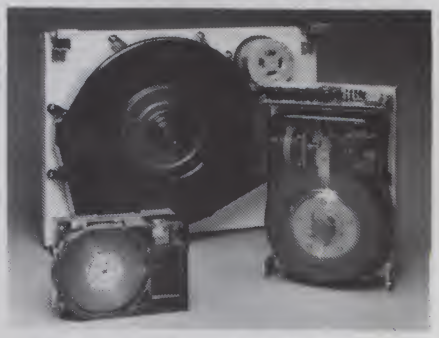
KDMDSF1218	Single Drive System	$1095.00	$950.00
KDMDSF1228	Dual Drive System	$1875.00	$1598.00

DJ2B DISCUS DOUBLE SIDED - MORROW

8" DBL Density/sided drives with cabinet Power supply controller, with CP/M 2.2 and Microsoft Basic

KDMDSF2218	Single Drive System	$1395.00	$1250.00
KDMDSF2228	Dual Drive System	$2495.00	$2050.00

S-100 HARD DISK - MORROW



5.25" 5MB, 8" 10 & 20MB, 14" 26MB formatted hard disk complete with cabinet, P.S., Controller, CP/M 2.2 and Microsoft MBASIC 80

		LIST PRICE	SALE PRICE
KDMDCMAMS	5 MB	$2495.00	$1995.00
KDMDSM10S	10 MB	$3695.00	$2950.00
KDMDSM20S	20 MB	$4795.00	$3825.00
KDMDSM26S	26 MB	$4495.00	$3495.00

WOW!



NEW!

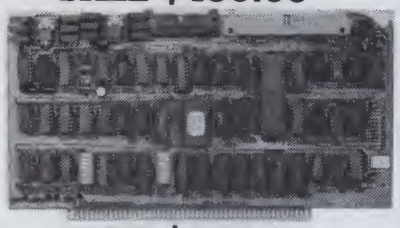
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USI has the competition buckling at their knees! You can have a professional performing Video Monitor for a **fraction of the cost!** *The USI EV2131N is a 12" Green, high resolution data display compatable with 80 x 24 computer formats*

KOUSIEV2131N	24 lbs.		$149.00

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GODBOUT DMA DISK 1 WITH FREE CP/M 2.2 SALE $450.00



SAVE $220.00

Priority 1 Electronics is pleased to offer the GODBOUT DISK 1 High Performance Disk Controller at our regular low price with CP/M 2.2 and BIOS at no additional cost. That's a savings of $220.00 of the manufacturer's list price.

- *Third generation INTEL 8272/NEC 765A LSI floppy disk controller.*
- *High speed cycle stealing DMA interface for processor independent data transfer between system memory and flexible disk.*
- *Handles up to four 8 or 5.25 inch floppy disk drives*
- *Single or double density/single or double sided capability.*
- *Supports IBM 3740 soft sectored formats.*
- *24 bit DMA addressing with data transfer across 64K boundaries for data transfer throughout the 16Mbyte memory map.*

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
KDPDB171ACPM	*A&T w/CP/M 2.2 & BIOS*	*$670.00*	**$450.00**
KDGBT171C	*CSC*	*$595.00*	**$555.00**
KDGBTCPM80*	*CP/M 2.2 for Z80/8085 with manuals & BIOS 8" S/D disk*		**$175.00**
KDGBTOASDS	*Oasis 8 bit single user 8" S/D disk*		**$500.00**
KDGBTOASDM	*Oasis 8 bit multiuser, 8" S/D disk*		**$650.00**

S-100 SYSTEMS

SUPERSIXTEEN — GODBOUT

HERE IS WHAT EACH PACKAGE INCLUDES:

KDGBT1612A *6 MHz 8085/8088 Dual Processor Board*
KDGBT171A *High Speed DMA Disk Controller*
KDGBT182A *System Support 1 Multi-Function Board*
KDGBT133A *Interfacer 1 Dual Serial I/O*
K0128K 1DMHz *Low Power Static Ram*
KDGBTCP/M 86 *16 Bit Operating System Ready to Load & Go*
Cables and Documentation *Three interfacer cables one disk I/O cable, complete documentator for all hardware, and manuals for both CP/M operating systems.*
Compu Pro's *famous* **1 Year** *limited warranty.*

Now to the best part of all. If purchased separately, these quality components would list for $4,344.00. **BUT SuperSixteen's low package price is an amazing $3,495.00. You save $849.00!** *(For boards qualified under the Certified System Component high-reliability program - with extended 2 year warranty, 200 hour burn-in and 6/8MHz processors - add $600.00 to the package price.* *Sh. Wt. 15 lbs.*

KDPDBGBTSJ	*SuperSixteen A&T*	**$3495.00**
KDPDBGBTSK	*SuperSixteen CSC*	**$4095.00**

PRINTERS

BEST PRICE!



MICROLINE — OKIDATA

WITH FRICTION AND TRACTOR FEED

- *Bi-DIRECTIONAL - 120 CPS*
- *9x9 Matrix (Alphanumeric)*
- *6x9 or 12 Matrix for Graphics*
- *5,8.3, 10,16 Charactrs p/Inch*
- *6 or 8 Lines per Inch*
- *80 CPL@10 CPI for 82A*
- *132 CPL@10 CPI for 83A*
- *Parallel and Serial I/O*
- *100 Thru 1200 Baud*
- *Self Test*
- *Out of Paper Switch*
- *Friction or Tractor Feed*
- *3" to 14" Top of Form (Switch Selectable)*
- *10 Different Character Sets*

PART NO.	DESCRIPTION	LIST PRICE	SALE PRICE
KDOKIDAT82AT(26 lbs)	*8 80 CPL @ 10 CPI*	*$ 799.00*	**$539.00**
KDOKIDAT83AT (37 lbs)	*132 CPL @ 10 CPI*	*$1195.00*	**$750.00**
KDOKISER2KBF	*9600 baud with 2K Serial Buffer upgrade with X-on Y-off*		**$150.00**
KDOKIGRAPH	*High Resolution Graphics Prom*		**$99.00**

CALL FOR THE NEW MICROLINE 84

MX80 — EPSON

NEED WE SAY MORE?

KDEPNMX80	*Tractor Feed 17 lbs*	*$645.00*	**$450.00**
KDEPNMX100	*132 Col. Tractor Feed 24 lbs*		**$725.00**

PRINTER INTERFACES - MICROBYTE

RS232 Serial Conversion for MX80

KDMBSSEI1	*A & T*	**$55.00**
	Apple Centronics 8 bit parallel interface for Centronics, Epson & OKIDATA printers	
KDMBSAEI1	*A & T*	**$55.00**
KDMBSAEC1	*Cable for above*	**$14.95**

Printer interfaces & cables sold only with printer purchase

S-100 MAINFRAMES



S-100 MICROFRAME - TEI

110V 60HZ CVT Mainframes, the best money can buy!
12 Slot ±8V 17A±16V @ 2A
22 Slot ±8V @ 30A± 16V @ 4A

PART NO.		LIST PRICE	OUR PRICE 1-9	10-24
KDTEIMCS 112	*12 Slot Desk*	*$685.00*	**$615.00**	**$570.00**
KDTEIMCS 122	*22 Slot Desk*	*$825.00*	**$760.00**	**$705.00**
KDTEIRM 12	*12 Slot Rackmount*	*$725.00*	**$720.00**	**$619.00**
KDTEIRM 22	*22 Slot Rackmount*	*$875.00*	**$850.00**	**$750.00**

Shipping Weight: On 12 Slot Mainframe 45 lbs.
On 22 Slot Mainframes 55 lbs.

TEI S-100 FRAMES
3 - 5" DISK CUTOUTS

±8V @ 17±16V @ 1.2A, Internal Cables

			1-9	10-24
KDTEITF12	*12 Slot desk*	*$675.00*	**$625.00**	**$580.00**
KDTEIRF12	*12 Slot Rackmount*	*$795.00*	**$715.00**	**$665.00**

Shipping Weight: On 12 Slot Desk 40 lbs.
On 12 Slot Rackmount 45 lbs.

DUAL 8" DISK DRIVE CHASSIS - TEI

For Shugart 800/801R or 850/851R with internal power cables provided
+24V @ 1.5A+5V @ 1.0A - 5V @ .25A

			1-9	10-24
KDTEBCF00	*Desk Top*	*$535.00*	**$485.00**	**$455.00**
KDTEIRF00	*Rack Mount*	*$720.00*	**$670.00**	**$630.00**
KDPDBDF00S1	*DFDO with 1 Shugart 801R*			**$1070.00**
KDPDBOF00S2	*DFDO with 2 Shugart 801Rs*			**$1375.00**
KDPDBRFD0S1	*RFDO with 1 Shugart 801R*			**$1095.00**
KDPDBRF00S2	*RFDO with 2 Shugart 801Rs*			**$1495.00**
KDPRI5DPGCE2	*Internal Data Cable .50 pin plug connector to 2 Card Edge*			**$34.95**

Due to UPS shipping regulations, disk drives will be shipped separately from the cabinet. Don't forget to include shipping for each drive. (Shipping Weight, 16 lbs each.)

CALL FOR NEW TEI PRICES APRIL 1st

S-100 MAINFRAME - GODBOUT

110V 60HZ CVT Mainframe uses famous 20 slot GODBOUT Motherboard. 55 lbs.

KDGBTENC20RM	*20 Slot Rack Mount*	*$895.00*	**$825.00**
KDGBTENC20DK	*20 Slot Desk Top*	*$825.00*	**$760.00**

S-100 MAINFRAME - CCS

12-slot motherboard with removable termination card

KDCCS22D001	*Office Cream*	*35 lbs*	*$575.00*	**$535.00**
KDCCS22D002	*Blue*	*35 lbs*	*$575.00*	**$535.00**

SOFTWARE - MICROPRO

All software is supplied on 8" Single Density IBM 3740 CP/M Compatable Diskettes

WORDSTAR

Screen-Oriented, integrated word processing system specifically designed for non-technical personnel

KDMPRWRDSTA1 *$495.00* **$300.00**

MAIL MERGE WORD STAR OPTION

Powerful file merging tool

KDMPRMLMRGA1 *(Requires Word Star 2.1 or later) $250.00* **$100.00**

SPELLSTAR WORD STAR OPTION

One Step "Proofreader" with compressed 20,000 word dictionary and user-created supplemental dictionaries

KDMPRSPLSTA1 *(Requires Word Star 3.0 or later) $250.00* **$150.00**

SUPERSORT

Sophisticated program that will select and re-arrange variable length information from data files

KDMPRSPRSRA1 *$250.00* **$150.00**

CALC STAR

Sophisticated, easy-to-use, electronic spread sheet and financial planner

KDMPRCLCSTA1 *$295.00* **$200.00**

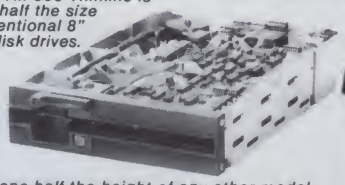
DATA STAR

Office-Oriented Data Entry, retrival, and updating system

KDMPRDATSTA1 *$350.00* **$200.00**

FLOPPY DISC DRIVES

Tandon TM-800 Thinline is exactly half the size of conventional 8" floppy disk drives.



ONE

Exactly one-half the height of any other model.
Propietary, high-resolution, read-write heads patented by Tandon
D.C. only operation - no A.C. required
Industry standard interface.
Three millisecond track-to-track access time *9 lbs.*

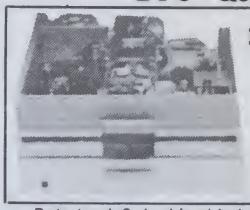
KDTNDTM8481	*Single Sided*	**$425.00**	*2 or more*	**$395.00**
KDTNDTM8482	*Double Sided*	**$575.00**	*2 or more*	**$550.00**
KDTNDTM8M	*Manual - not included with drive*			**$ 10.00**

801R - SHUGART

Single sided double density most popular 8" drive

KDSHU801R	*$425.00 ea or 2 or more (16 lbs) for*	**$395.00 ea.**
KDSHUSA801RM	*Manual for 801R drives*	**$ 10.00**

DT-8 - QUME



DT-8 - QUME

2 OR MORE $499.00

Data track 8 double sided, double density 8"

KDQMEDT8WH *Sh.Wt. 16 lbs.* **$525.00 ea.**

2 or more $499.00 each

KDQMEDT8M *Manual for DT-8* **$ 10.00**

5¼" DRIVES - TANDON

KDTNDTM1DD1	*Single Sided, 250KB (5 lbs)*	**$310.00**
KDTNDTM1DD2	*Double Sided, 500KB*	**$370.00**
KDTNDTM1DD3	*Single Sided, 500KB*	**$375.00**
KDTNDTM1004	*Double Sided, 1000KB*	**$495.00**
KDTNDTM5M	*Manual, not included with drive*	**$ 10.00**

DISK CABINETS



V-100 - VISTA

- *Desk or rack mountable* • *Internal power and data cables* • *Drives pull out for easy service and maintenance*

KDVISV1DD *Disk Drive Cabinet (43 lbs)* *$495.00* **$449.00**

SINGLE 8" - Q.T.

Single 8" cabinet with power supply

KDQTCDDC8 *(22 lbs)* *$249.00* **$225.00**

DUAL 8" - Q.T.

Dual 8' cabinet with power supply

KDQTCDDC86 *(24)* *$395.00* **$349.00**

5" CABINETS - VISTA

KDVIS 96D1	*Single 5" with P.S.*	**$75.00**
KDVIS 96D2	*Dual 5" with P.S.*	**$95.00**

TERMINALS



SALE! $525.00

VIEWPOINT — ADDS

Detachable keyboard, RS232 interface and auxiliary port, 80 x 24 display, tiltable screen **SALE**

KDADDVWPR *Shipping Weight 40 lbs* *$699.00* **$525.00**

VT200 — VISUAL TECHNOLOGY

THE MOST RELIABLE TERMINAL WE'VE EVER USED!

Detachable keyboard, RS232C or 20MA interface, 110 to 19200 baud, 12" non glare 80 x 24 display, RS232 Aux. port and composite video out.

KDVSL200 *Shipping Weight 55 lbs.* **$995.00**

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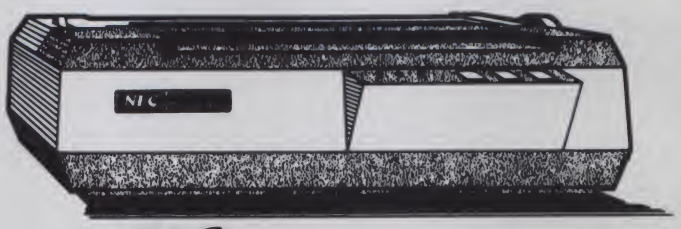
Terms U.S. VISA, MC, BAC, Check, Money Order, U.S. Funds Only. CA residents add 6% Sales Tax. MINIMUM PREPAID ORDER $15.00. Include MINIMUM SHIPPING & HANDLING of $2.50 for the first 3 lbs. plus 25¢ for each additional pound. Orders over 50 lbs. sent freight collect. Just in case, please include your phone no. Prices subject to change without notice. We will do our best to maintain prices through April, 1982. Credit Card orders will be charged appropriate freight. See November **BYTE** for 60 page Catalog or send $1.00 for your copy today. Sale prices are for prepaid orders only.

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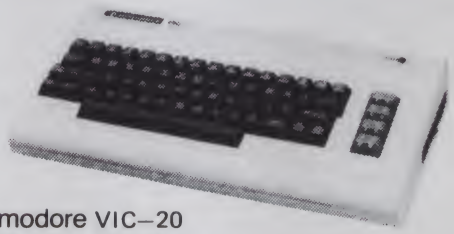


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A dot-matrix, bi-directional, logic-seeking, friction or tractor feed, impact printer.



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SD Systems ExpandoRAM III

256K RAM $879.95

Single User System

SBC-200, 64K ExpandoRAM II, Versafloppy II, CP/M 2.2

$1095.00

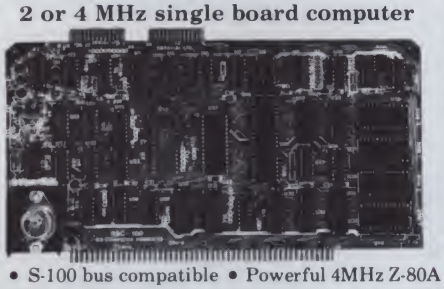
4 MHz Z-80A CPU, 64K RAM, serial I/O port, parallel I/O port, double-density disk controller, CP/M 2.2 disk and manuals, system monitor, control and diagnostic software.

Add $100.00 for upgrade to ExpandoRAM III 64K (expandable to 256K)

-All boards are assembled and tested-

SBC-200

2 or 4 MHz single board computer



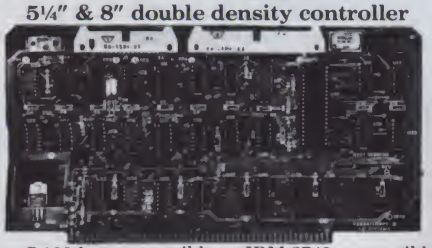
• S-100 bus compatible • Powerful 4MHz Z-80A CPU • Synchronous/asynchronous serial I/O port with RS-232 interface and software programmable baud rates up to 9600 baud • Parallel input and parallel output port • Four channel counter/timer • Four maskable, vectored interrupt inputs and a non-maskable interrupt • 1K of on-board RAM • Up to 32K of on-board ROM • System monitor PROM included

The SBC-200 is an excellent CPU board to base a microcomputer system around. With on-board RAM, ROM, and I/O, the SBC-200 allows you to build a powerful three-board system that has the same features found in most five-board microcomputers. The SBC-200 is compatible with both single-user and multi-user systems.

CPU-30200A *A & T with monitor* **$299.95**

Versafloppy II

5¼" & 8" double density controller



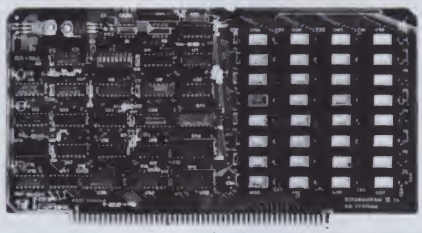
• S-100 bus compatible • IBM 3740 compatible soft sectored format • Controls single and double-sided drives, single or double density, 5¼" and 8" drives in any combination of four simultaneously • Drive select and side select circuitry • Analog phase-locked loop data seperator • Vectored interrupt operation optional • Standard CP/M 2.2 disk operating • Control/diagnostic software PROM included

The Versafloppy II is faster, more stable and more tolerant of bit shift and "jitter" than most controllers. All control and diagnostic software included.

IOD-1160A *A & T* **$359.95**
For CP/M 2.2 and manual set add **$99.95**

ExpandoRAM III

64K to 256K expandable RAM board



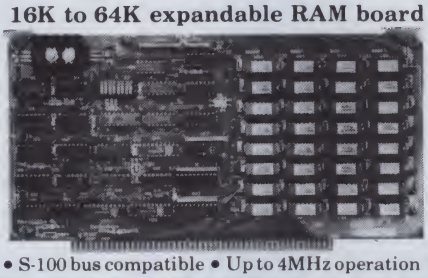
SD Systems has duplicated the famous reliability of their ExpandoRAM I and II boards in the new ExpandoRAM III, a board capable of containing 256K of high speed RAM. Utilizing the new 64K x 1 dymanic RAM chips, you can configure a memory of 64K, 128K, 192K, or 256K, all on one S-100 board. Memory address decoding is done by a programmed bipolar ROM so that the memory map may be dip-switch configured to work with either COSMOS/MPM-type systems or with OASIS-type systems.

Extensive application notes concerning how to operate the ExpandoRAM III with Cromemco, Intersystems, and other popular 4 MHz Z-80 systems are contained in the manual.

MEM-65064A *64K A & T* **$495.00**
MEM-65128A *128K A & T* **$639.95**
MEM-65192A *192K A & T* **$769.95**
MEM-65256A *256K A & T* **$879.95**

ExpandoRAM II

16K to 64K expandable RAM board



• S-100 bus compatible • Up to 4MHz operation • Expandable from 16K to 64K • Uses 16 x 1 4116 memory chips • Page mode operation allows up to 8 memory boards on the bus • Phantom output disable • Invisible on-board refresh

The ExpandoRAM II is compatible with most S-100 CPUs. When other SD System' series II boards are combined with the ExpandoRAM II, they create a microcomputer system with exceptional capabilities and features.

MEM-16630A *16K A & T* **$345.00**
MEM-32631A *32K A & T* **$365.00**
MEM-48632A *48K A & T* **$385.00**
MEM-64633A *64K A & T* **$399.95**

PROM-100

Versatile EPROM Programmer

• S-100 bus compatible • Programs 2708, 2758, 2716, 2732, 2516 EPROMs • DIP switch selection of EPROM type • 25 VDC programming pulse generated on-board • Very fast programming and verification • Zero insertion force socket • Programming software included on 8" diskette

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MEM-99520A *A & T w/ software* ... **$249.95**

Multi-User System

SBC-200, 256K ExpandoRAM III, Versafloppy II, MPC-4 COSMOS Multi-User Operating System, C BASIC II

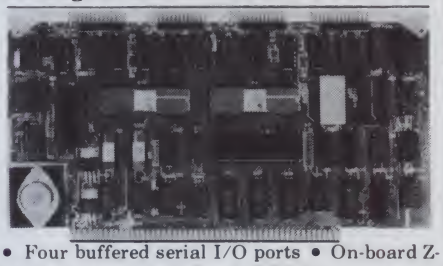
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Two Z-80A CPUs (4 MHz), 256K RAM, 5 serial I/O ports with independently programmable baud rates and vectored interrupts, parallel input port, parallel output port, 8 counter/timer channels, real time clock, single and double sided/single or double density disk controller for 5¼" and 8" drives, up to 36K of on-board ROM, CP/M 2.2 compatible COSMOS interrupt driven multi-user disk operating system, allows up to 8 users to run independent jobs concurrently, C BASIC II, control and diagnostic software in PROM included.

-All boards are assembled and tested-

MPC-4

Intelligent communications interface



• Four buffered serial I/O ports • On-board Z-80A processor • Four CTC channels • Independently programmable baud rates • Vectored interrupt capability • Up to 4K of on-board PROM • Up to 2K of on-board RAM • On-board firmware

This is not just another four-port serial I/O board! The on-board processor and firmware provide sufficient intelligence to allow the MPC-4 to handle time consuming I/O tasks, rather than loading down your CPU. To increase overall efficiency, each serial channel has an 80 character input buffer and a 128 character output buffer. The on-board firmware can be modified to make the board SDLC or BISYNC compatible. In combination with SD's COSMOS operating system (which is included with the MPC-4), this board makes a perfect building block for a multi-user system.

IOI-1504A *A & T with COSMOS* .. **$495.00**

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Microline 82A *80/132 column, **120 CPS**, 9 x 9 dot matrix, friction feed, pin feed, adjustable tractor feed (removable), handles 4 part forms up to 9.5" wide, rear & bottom feed, paper tear bar, 100% duty cycle/200,000,000 character print head, bi-directional/logic seeking, both serial & parallel interfaces included, front panel switch & program control of 10 different form lengths, uses inexpensive spool type ribbons, double width & condensed characters, true lower case descenders & graphics*

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Microline 83A *132/232 column, 120 CPS, handles forms up to 15" wide, plus all the features of the 82A.*

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PRA-27082 *Apple cable* **$19.95**
PRA-27087 *TRS-80 cable* **$24.95**
PRA-43081 *Hi speed 2K serial board* **$169.95**
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PRM-27100 *List $945* **$759.95**

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PRA-27081 *Apple card* **$74.95**
PRA-27082 *Apple cable* **$22.95**
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SMARTMODEM - Hayes

Sophisticated direct-connect auto-answer/auto-dial modem, touch-tone or pulse dialing, RS-232C interface, programmable

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D-CAT *300 baud direct connect, answer/orginate*
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AUTO-CAT *Auto answer/orginate, direct connect*
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Apple-CAT - Novation

Software selectable 1200 or 300 baud, direct connect, auto-answer/auto-dial, auxiliary 3-wire RS232C serial port for printer.

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IOD-2370A *Micro Sci A70* **$499.95**

Micro Sci Controller *Disk controller for up to two Micro Sci A40 or A70 disk drives, DOS 3.2, 3.3, Pascal, and Z-80 SoftCard compatible, includes utility disk and 40/70 track patch.*

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80 column x 24 line video card for Apple II, 128 ASCII characters, upper and lower case, 9 x 10 dot matrix with 3 dot descenders, standard data media terminal control codes, CP/M Pascal & Fortran compatible, 50/60 Hz

IOV-2400A *Vista Vision 80* **$375.00**

AIO, ASIO, APIO - S.S.M.

Parallel & serial interface for your Apple (see Byte pg 11)

IOI-2050K *Par & Ser kit* **$139.95**
IOI-2050A *Par & Ser A & T* **$169.95**
IOI-2052K *Serial kit* **$89.95**
IOI-2052A *Serial A & T* **$99.95**
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IOI-2054A *Parallel A & T* **$89.95**

CPS MULTICARD - Mtn. Computer

Three cards in one! Real time clock/calendar, serial interface, & parallel interface - all on one card.

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TELEVIDEO 950

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Detachable keyboard, amber on black display, 7 x 9 dot matrix, 10 program function keys, 14 key numeric pad, 12" non-glare screen, 50 to 19,200 baud, direct cursor control, auxiliary bi-directional serial port

VDT-351200 *List $795.00* **$645.00**

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2/4 MHz Z-80A CPU with RS-232C serial I/O port and on board MOSS 2.2 monitor PROM, front panel compatible*

CPU-30400A *A & T* **$269.95**

CB-2 Z-80 CPU - S.S.M.
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S-100 PROM Boards

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2708, 2716, 2732 EPROM programmer w/software

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MEM-99520A *A & T* **$249.95**

PB-1 - S.S.M.
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MEM-99510A *A & T* **$219.95**

EPROM BOARD - Jade
16K or 32K uses 2708's or 2716's, 1K boundary

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MBS-121K *Kit* **$69.95**
MBS-121A *A & T* **$89.95**

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64K RAM - Calif Computer Sys
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64K STATIC RAM - Mem Merchant
64K static S-100 RAM card, 4-16K banks, up to 8MHz

MEM-64400A *A & T* **$789.95**

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2 or 4 MHz expandable static RAM board uses 2114L's

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MEM-32151K *32K 4 MHz kit* **$299.95**
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16K STATIC RAM - Mem Merchant
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MEM-16171A *A & T* **$164.95**

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Double density controller with the inside track, on-board Z-80A, printer port, IEEE S-100, can function on an interrupt driven buss*

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IOI-1046A *A & T* **$299.95**
IOI-1045B *Bare board w/ manual* ... **$49.95**

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2 serial I/O ports plus 2 parallel I/O ports

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MAINFRAME - Cal Comp Sys
12 slot S-100 mainframe with 20 amp power supply

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Handsome metal cabinet with proportionally balanced air flow system • Rugged dual drive power supply • Power cable kit • Power switch, line cord, fuse holder, cooling fan • Never-Mar rubber feet • All necessary hardware to mount 2-8" disk drives, power supply, and fan • Does not include signal cable

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Single Sided, Double Density

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END-000434 *A & T w/2 SA-801Rs* **$1195.00**

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END-000427 *A & T w/2 DT-8s* ... **$1424.95**
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MSM-750050 .. $359.95 ea 2 for **$349.95 ea**

MPI B-51 *sngl-sided dbl-density 40 track*
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MSM-155300 .. $369.95 ea 2 for **$359.95 ea**

MPI B-92 *dbl-sided dbl-density 77 track*
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Qume DT-8 *double-sided double-density*
MSF-750080 .. $524.95 ea 2 for **$499.95 ea**

Siemens FDD 100-8 *sngl-sided dbl-density*
MSF-201120 .. $384.95 ea 2 for **$349.95 ea**

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S-100 diagnostic analyzer board, dynamic visual display of all 96 IEEE S-100 signals, aids in real time analysis of faulty hardware and software

TSX-200B *Bare Board* **$59.95**
TSX-200K *Kit* **$119.95**
TSX-200A *A & T* **$149.95**

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MEMOREX

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8″ SSSD IBM Compatible (128 B/S, 26 Sectors)	**3062**	2.09
8″ SSSD Shugart Compatible, 32 Hard Sector	**3015**	2.09
8″ SSDD IBM Compatible (128 B/S, 26 Sectors)	**3090**	2.74
8″ DSDD Soft Sector (Unformatted)	**3102**	3.14
8″ DSDD Soft Sector (128 B/S, 26 Sectors)	**3115**	3.34
8″ DSDD Soft Sector (1024 B/S, 8 Sectors)	**3104**	3.34
8″ DSDD Burroughs B-80 Comp., 32 Hard Sector	**3092**	3.34
5¼″ SSSD Soft Sector (Unformatted)	**3401**	1.94
5¼″ SSDD Soft Sector w/Hub Ring	**3481**	2.34
5¼″ SSDD 10 Hard Sector w/Hub Ring	**3483**	2.34
5¼″ SSDD 16 Hard Sector w/Hub Ring	**3485**	2.34
5¼″ DSDD Soft Sector w/Hub Ring	**3491**	3.09
5¼″ DSDD 10 Hard Sector w/Hub Ring	**3493**	3.09
5¼″ DSDD 16 Hard Sector w/Hub Ring	**3495**	3.09

SSSD = Single Sided Single Density; SSDD = Single Sided Double Density
DSDD = Double Sided Double Density

Memorex Flexible Discs...The Ultimate in Memory Excellence

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Customer-Oriented Packaging
Memorex's commitment to excellent does not stop with a quality product. They are proud of their flexible discs and they package them with pride. Both their packaging and their labeling have been designed with your ease of identification and use in mind. The desktop box containing ten discs is convenient for filing and storage. Both box labels and jacket labels provide full information on compatibility, density, sectoring, and record length. Envelopes with multi-language care and handling instructions and and color-coded removable labels are included. A write-protect feature is available to provide data security.

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Memorex Flexible Discs will be replaced free of charge by Memorex if they are found to be defective in materials or workmanship within one year of the date of purchase. Other than replacement, Memorex will not be responsible for any damages or losses (including consequential damages) caused by the use of Memorex Flexible Discs.

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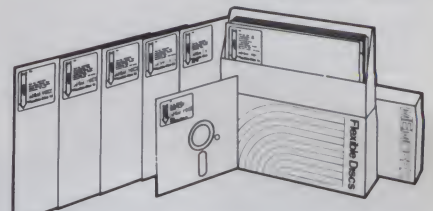
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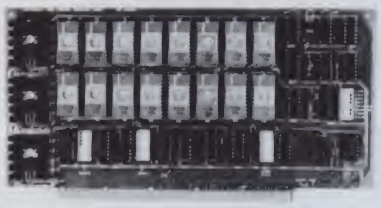
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32K S-100 EPROM CARD

NEW!



$79.95 KIT

USES 2716's

Blank PC Board - $34

ASSEMBLED & TESTED ADD $30

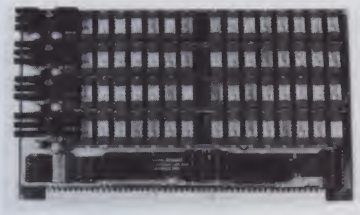
SPECIAL: 2716 EPROM's (450 NS) Are $9.95 Ea. With Above Kit.

KIT FEATURES:

1. Uses +5V only 2716 (2Kx8) EPROM's.
2. Allows up to 32K of software on line!
3. IEEE S-100 Compatible.
4. Addressable as two independent 16K blocks.
5. Cromemco extended or Northstar bank select.
6. On board wait state circuitry if needed.
7. Any or all EPROM locations can be disabled.
8. Double sided PC board, solder-masked, silk-screened.
9. Gold plated contact fingers.
10. Unselected EPROM's automatically powered down for low power.
11. Fully buffered and bypassed.
12. Easy and quick to assemble.

32K SS-50 RAM

$259.95 KIT



For 2MHZ Add $10

Blank PC Board $50

For SWTPC 6800 - 6809 Buss

Support IC's and Caps $19.95

Complete Socket Set $21.00

Fully Assembled, Tested, Burned In Add $30

At Last! An affordable 32K Static RAM with full 6809 Capability.

FEATURES:

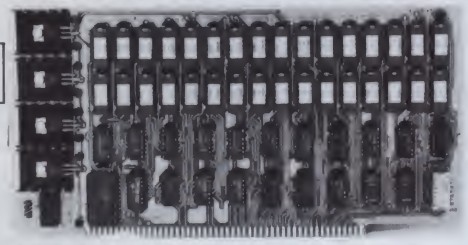
1. **Uses proven low power 2114 Static RAMS.**
2. **Supports SS50C - EXTENDED ADDRESSING.**
3. **All parts and sockets included.**
4. **Dip Switch address select as a 32K block.**
5. **Extended addressing can be disabled.**
6. **Works with all existing 6800 SS50 systems.**
7. **Fully bypassed. PC Board is double sided, plated thru, with silk screen.**

16K STATIC RAM KIT-S 100 BUSS

PRICE CUT!

$149.95 KIT

FOR 4MHZ ADD $10



KIT FEATURES:

1. Addressable as four separate 4K Blocks.
2. ON BOARD BANK SELECT circuitry. (Cromemco Standard!). Allows up to 512K on line!
3. Uses 2114 (450NS) 4K Static Rams.
4. ON BOARD SELECTABLE WAIT STATES.
5. Double sided PC Board, with solder mask and silk screened layout. Gold plated contact fingers.
6. All address and data lines fully buffered.
7. Kit includes ALL parts and sockets.
8. PHANTOM is jumpered to PIN 67.
9. LOW POWER: under 1.5 amps TYPICAL from the +8 Volt Buss.
10. Blank PC Board can be populated as any multiple of 4K.

BLANK PC BOARD W/DATA-**$33**

LOW PROFILE SOCKET SET-**$12**

SUPPORT IC'S & CAPS-**$19.95**

ASSEMBLED & TESTED-**ADD $35**

OUR #1 SELLING RAM BOARD!

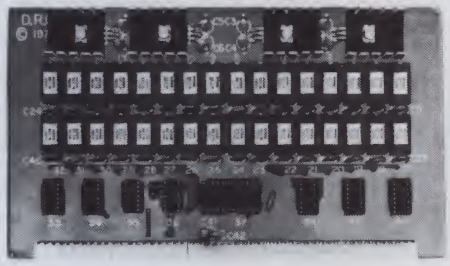
16K STATIC RAM SS-50 BUSS

PRICE CUT!

$139.95 KIT

FULLY STATIC!

FOR 2MHZ ADD $10



FOR SWTPC 6800 BUSS!

ASSEMBLED AND TESTED - $35

KIT FEATURES:

1. Addressable on 16K Boundaries
2. Uses 2114 Static Ram
3. Fully Bypassed
4. Double sided PC Board Solder mask and silk screened layout
5. All Parts and Sockets included
6. Low Power Under 1.5 Amps Typical

BLANK PC BOARD—**$35** COMPLETE SOCKET SET—**$12**

SUPPORT IC'S AND CAPS—**$19.95**

NEW! **STEREO!** NEW!

S-100 SOUND COMPUTER BOARD

At last, an S-100 Board that unleashes the full power of two unbelievable General Instruments AY3-8910 NMOS computer sound IC's. Allows you under total computer control to generate an infinite number of special sound effects for games or any other program. Sounds can be called in BASIC, ASSEMBLY LANGUAGE, etc.

COMPLETE KIT! $84.95 (WITH DATA MANUAL)

BLANK PC BOARD W/DATA $31

KIT FEATURES:

- ★ TWO GI SOUND COMPUTER IC'S.
- ★ FOUR PARALLEL I/O PORTS ON BOARD.
- ★ USES ON BOARD AUDIO AMPS OR YOUR STEREO.
- ★ ON BOARD PROTO TYPING AREA.
- ★ ALL SOCKETS, PARTS AND HARDWARE ARE INCLUDED.
- ★ PC BOARD IS SOLDERMASKED, SILK SCREENED, WITH GOLD CONTACTS.
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- ★ USES PROGRAMMED I/O FOR MAXIMUM SYSTEM FLEXIBILITY.

Both Basic and Assembly Language Programming examples are included.

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TR1602B — SAME AS TMS6011, AY5-1013, ETC. 40 PIN DIP

TR1602B

$2.95 EACH **4 For $10.00**

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4K STATIC RAM

National Semi. MM5257. Arranged 4K x 1. +5V, 18 PIN DIP. A Lower Power, Plug in Replacement for TMS 4044. 450 NS. Several Boards on the Market Will Accept These Rams. SUPER SURPLUS PURCHASE! **PRIME NEW UNITS!**

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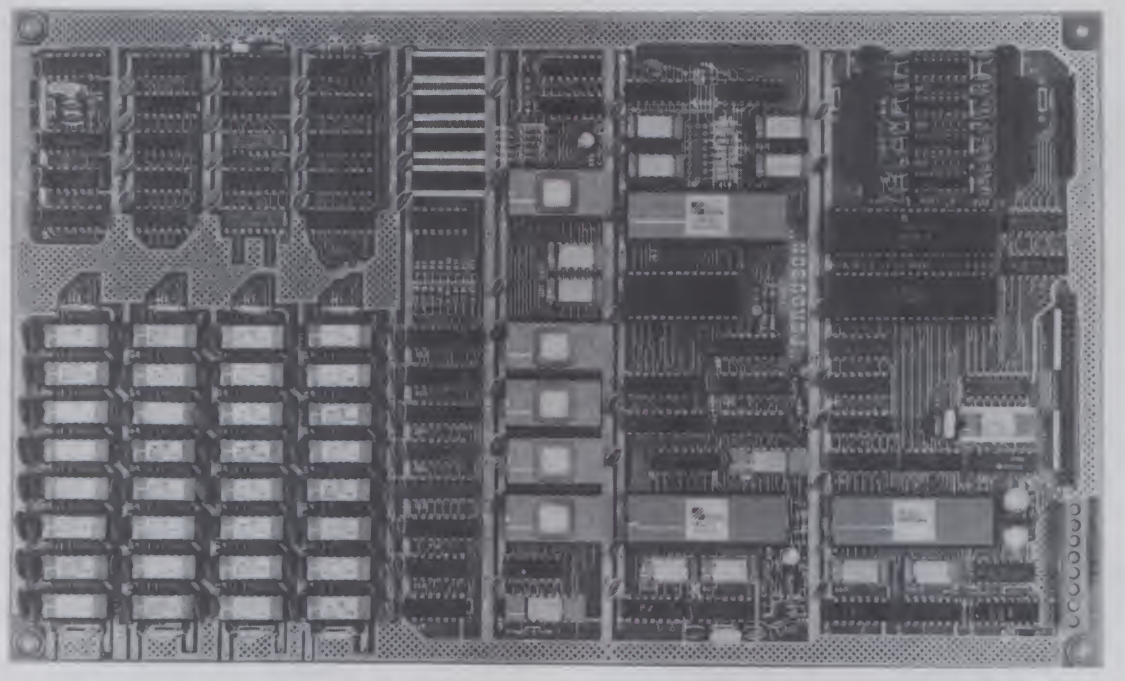
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Z-80 CPU! 64K RAM!

NEW!

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For All Sockets Installed
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WANT MORE INFO?
Full Documentation and
Schematics — $5.

THE FERGUSON PROJECT: Three years in the works, and maybe too good to be true. A tribute to hard headed, no compromise, high performance, American engineering! The Big Board gives you all the most needed computing features on one board at a very reasonable cost. The Big Board was designed from scratch to run the latest version of CP/M*. Just imagine all the off-the-shelf software that can be run on the Big Board without any modifications needed! Take a Big Board, add a couple of 8 inch disc drives, power supply, an enclosure, C.R.T., and you have a total Business System for about 1/3 the cost you might expect to pay.

$499.00 ** (64K KIT BASIC I/O)

SIZE: 8½ x 13¾ IN.
SAME AS AN 8 IN. DRIVE.
REQUIRES: +5V @ 3 AMPS
+ - 12V @ .5 AMPS.

FULLY SOCKETED!

FEATURES: (Remember, all this on one board!)

64K RAM

Uses industry standard 4116 RAM'S. All 64K is available to the user, our VIDEO and EPROM sections do not make holes in system RAM. Also, very special care was taken in the RAM array PC layout to eliminate potential noise and glitches.

Z-80 CPU

Running at 2.5 MHZ. Handles all 4116 RAM refresh and supports Mode 2 INTERUPTS. Fully buffered and runs 8080 software.

SERIAL I/O (OPTIONAL)

Full 2 channels using the Z80 SIO and the SMC 8116 Baud Rate Generator. FULL RS232! For synchronous or asynchronous communication. In synchronous mode, the clocks can be transmitted or received by a modem. Both channels can be set up for either data-communication or data-terminals. Supports mode 2 Int. Price for all parts and connectors: $65.

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Consists of a separate parallel port (Z80 PIO) for use with an ASCII encoded keyboard for input. Output would be on the 80 x 24 Video Display.

24 x 80 CHARACTER VIDEO

With a crisp, flicker-free display that looks extremely sharp even on small monitors. Hardware scroll and full cursor control. Composite video or split video and sync. Character set is supplied on a 2716 style ROM, making customized fonts easy. Sync pulses can be any desired length or polarity. Video may be inverted or true. 5 x 7 Matrix - Upper & Lower Case

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Uses WD1771 controller chip with a TTL Data Separator for enhanced reliability. IBM 3740 compatible. Supports up to four 8 inch disc drives. Directly compatible with standard Shugart drives such as the SA800 or SA801. Drives can be configured for remote AC off-on. Runs CP/M* 2.2.

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Uses Z-80 PIO. Full 16 bits, fully buffered, bi-directional. User selectable hand shake polarity. Set of all parts and connectors for parallel I/O: $19.95

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BLANK PC BOARD — $175

The blank Big Board PC Board comes complete with full documentation (including schematics), the character ROM, the PFM 3.3 MONITOR ROM, and a diskette with the source of our BIOS, BOOT, and PFM 3.3 MONITOR.

CP/M* 2.2 FOR BIG BOARD

The popular CP/M* D.O.S. to run on Big Board is available for $159.00.

PRICE CUT!

PFM 3.3 2K SYSTEM MONITOR

The real power of the Big Board lies in its PFM 3.0 on board monitor. PFM commands include: Dump Memory, Boot CP/M*, Copy, Examine, Fill Memory, Test Memory, Go To, Read and Write I/O Ports, Disc Read (Drive, Track, Sector), and Search. PFM occupies one of the four 2716 EPROM locations provided.

Z-80 is a Trademark of Zilog.

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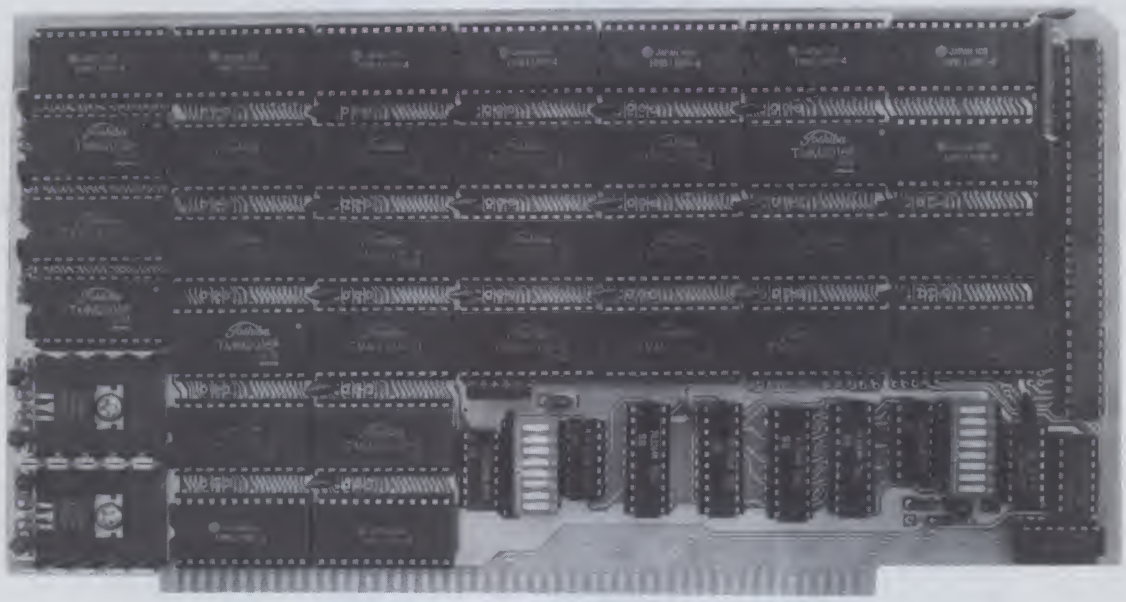
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FULLY SUPPORTS THE NEW IEEE 696 S100 STANDARD (AS PROPOSED)

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- ★ BOARD may be partially populated as 56K.

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SN7417N	29	SN74153N	56
SN7420N	17	SN74154N	1 25
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SN7430N	17	SN74157N	58
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SN7438N	24	SN74161N	65
SN7440N	19	SN74163N	85
SN7442N	45	SN74164N	87
SN7443N	42	SN74165N	55
SN7445N	84	SN74174N	88
SN7451N	19	SN74175N	79
SN7454N	19	SN74180N	75
SN7474N	27	SN74181N	1 15
SN7475N	36	SN74393N	1 65

74LS00

74LS00	29	74LS158	89
74LS02	29	74LS161	83
74LS03	29	74LS162	89
74LS04	29	74LS163	89
74LS05	29	74LS164	85
74LS06	29	74LS165	85
74LS08	29	74LS169	1 55
74LS10	29	74LS170	1 75
74LS14	89	74LS174	85
74LS20	29	74LS175	85
74LS21	29	74LS190	85
74LS29	60	74LS191	1 25
74LS27	29	74LS195	85
74LS28	37	74LS197	78
74LS30	29	74LS221	1 25
74LS32	31	74LS240	1 65
74 S38	31	74LS241	1 65
74LS42	63	74LS243	1 55
74LS48	77	74LS244	1 55
74LS74	36	74LS245	2 45
74LS75	55	74LS251	1 25
74LS86	45	74LS253	85
74LS90	85	74LS257	85
74LS93	95	74LS258	1 85
74LS95	80	74LS260	55
74LS107	43	74LS273	1 55
74LS113	45	74LS279	45
74LS122	45	74LS290	1 25
74LS123	89	74LS293	1 85
74LS125	89	74LS365	85
74LS126	79	74LS367	75
74LS138	64	74LS373	1 45
74LS139	59	74LS374	1 45
74LS151	49	74LS377	1 25
74LS153	49	74LS640	1 55
74LS157	89	74LS670	1 85

74S00

74S00	39	74S138	75
74S02	45	74S140	1 00
74S03	38	74S158	75
74S04	39	74S174	1 35
74S05	39	74S175	1 35
74S10	39	74S182	75
74S15	45	74S189	4 25
74S20	55	74S201	6 75
74S22	55	74S240	2 75
74S30	75	74S244	2 95
74S37	55	74S251	2 75
74S50	55	74S287	2 95
74S51	49	74S288	2 95
74S64	55	74S299	5 75
74S74	65	74S470	9 25
74S86	95	74S471	9 50
74S112	1 95	74S473	9 50
74S132	1 45	74S474	9 50

EPROMS

2708	3.25ea	8 for 2.95ea
2716	5.50 ea	8 for 5.00ea
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MC1330AP	1.60		
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LM739	.90		
LM386	1.30		

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	10/5.30	14	10/1.30
	10/5.70	16	10/1.40
	10/6.70	18	10/1.80
	10/9.70	20	10/2.70
	10/12.70	22	10/2.70
	10/13.70	24	10/2.70
	10/14.70	28	10/3.00
	10/17.70	40	10/3.90
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	1.30		

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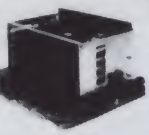
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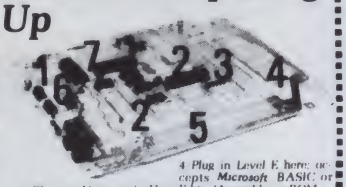
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Edited by Lise Markus

Ciarcia is Not for the Novice
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Build Your Own Z-80 Computer, Design Guidelines And Applications Notes

Steve Ciarcia
Byte Books, 1981
Paperback, 332 pp., $15.95

Criticizing a Steve Ciarcia do-it-yourself work is a bit like saying that Porsche doesn't know how to build automobiles, but I will do it anyway.

In case you are not familiar with his writing, Ciarcia produces a monthly column for *Byte* magazine, discussing how to build projects ranging from speech synthesizers to communication by laser beam. These articles are informative, accurate and fun to read. This book does not measure up to such high standards.

To begin with, the cover is misleading. In addition to the title, there is a picture of an S-100 bus format prototype plugboard full of ICs. This combination of title and photo would indicate to the bookstore browser that the project concerns the construction of an S-100-compatible Z-80-based computer. Way back on page *183*, however, the author points out that the project computer is intended as a trainer, and other use would require "considerably more memory and peripherals." Since the project includes 1K byte each of RAM and ROM, this disclaimer is somewhat of an understatement.

To get from 1K byte of RAM to a configuration usable as a computer usually requires the use of dynamic RAM chips, and the *Z-80*, with its built-in refresh circuitry, greatly simplifies the construction of a dynamic RAM main memory. Curiously, this book does not even mention the existence of this feature of the Z-80, or the economic benefits of dynamic memory. Because, simply, this is not a book on building a computer.

It is actually a book giving "design guidelines and application notes" useful to the experienced experimenter interested in building an "Applications Processor" that would be "a natural for intelligent control applications." Why doesn't the cover say so?

Once the reader becomes aware that the subject matter is not how to build an S-100 computer, he can proceed to discover that the subject matter is dated. About 1977, I'd guess. The selection of CPU chip (the 8085 is not even mentioned, and would be a better choice for a controller of this size) and supporting devices (7442 decoder instead of 74138) indicate that most of the material was written five years ago, even though this is a "new" book published in 1981.

It doesn't really matter, because in spite of all the above put-downs, the book is a valuable source of information on a wide-ranging list of topics that would be of interest to the experimenter. It is not a step-by-step how-to-build-it text for the beginner. Keeping this in mind, the true value of the information contained in the book becomes more obvious.

I especially like the opening chapter on power supplies. Ciarcia points out the usual design errors found in even some commercial equipment. *Nobody* bothers to design power supplies anymore. Just throw some parts together, copying the circuit from any old equipment schematic, and hang an integrated circuit regulator on the output to smooth things out. Well, you can get away with things like that most of the time, but until you read Steve's first chapter you won't really know what is going on inside this much-neglected portion of all electronic equipment.

Too much of the rest of the book does not include such detailed information on the circuits shown. For instance, a couple of crystal-controlled oscillator schematics are given in Fig. 4.3, with no mention of the fact that digital logic circuits are being used as linear amplifiers. Other bits and pieces of circuitry are included throughout the book that might be more useful if their theory of operation, when not straightforward and obvious, were to be explained. Since there is a lot of redundancy in the subject matter, the book might have been better written with more-detailed coverage of fewer circuits.

Perhaps with fewer circuits in the book, the artwork could have been better proofread, and that poor D to A converter in Fig. 8.10 wouldn't be trying to pump its output into an infinite signal sink. And maybe that one pin on the baud rate generator in Fig. 5.12 wouldn't be trying to provide both 4800 Hz and 16 times 4800 Hz at the same time.

The purpose of this nitpicking is to point out that this book contains guidelines and notes useful to the experimenter, not hard facts and proven designs reproducible by the novice. It also contains artwork and typo errors that will have to be sifted out by the more experienced reader.

If you are an experienced hardware hacker, but have yet to build your own microprocessor-based controller or computer, you will find this book a gold mine of useable circuitry. Just be forewarned that there are typos, and circuits that won't work without some debugging. And some of the devices might be better

replaced with more modern types.

In spite of these deficiencies, this is an informative book, and like all Ciarcia's writing, enjoyable to read.

Ken Barbier
Borrego Springs, CA

Apple Pascal: A Hands-On Approach

Arthur Luehrmann
and Hebert Peckham
McGraw-Hill
Paperback, 431 pp., $14.95

Pascal Programming For the Apple

T.G. Lewis
Reston Publishing Co.
Paperback, 234 pp., $12.95

My only complaint about *Apple Pascal: A Hands-On Approach* is that it should have been published two years ago when I wanted it so badly. It does a superb job of meeting an important need in the microcomputer field, and it should do a lot to stimulate the widespread use of Pascal in computers for the home and small businesses. If you have considered adding the language system to your Apple II (or bought one and finally gave up on it), the Luehrmann-Peckham book is exactly what you need. It is specifically designed for the beginner, and it tells you everything you need to know to get through the initial stages of programming.

Perhaps it can best be described as the Pascal counterpart of the Applesoft Tutorial (without the typos). The authors have gone to great pains to eliminate errors (especially in the example programs); I couldn't find anything that didn't work when I typed it correctly. They've used well-established instructional techniques, and have adapted them effectively for practice at the computer keyboard. Like all good teachers, the authors have been careful to repeat and reenforce previous points as new topics are introduced. Even the book's format is helpful—the spiral binding allows the book to open flat, quite a convenience at the computer.

It is often repeated that "Pascal is really a very powerful language, but it is a bit difficult at the beginning"; and that is certainly true for those of us who were new programmers when the Apple language system first appeared. Using the old white book that came with the 1.0 version of Apple Pascal, it took my wife and me a week to get the system in operation. Even the newer 1.1 version is still introduced with the warning that "you must have a thorough knowledge of Standard or UCSD Pascal, or use some book or manual that fully describes Standard or UCSD Pascal." The identity of the "some book or manual" is left hazy—probably because no suitable publication was available at the time the manual was written.

The absence of such books is curious because the Pascal language is frequently described as being designed to teach good programming practices to beginners. That may be true, but until *Apple Pascal* the poor beginner first had to figure out how to turn on the machine, and the sophisticated operating system that accompanies UCSD Pascal can be pretty frightening to a rank beginner. This has probably scared off a good many people who might have found the greater operating speed and excellent file-handling capacity of Pascal well suited to their needs.

Pascal includes a lot of features that simply have no convenient counterpart in Basic, and the Luehrmann and Peckham book starts with an interesting and useful discussion of the relative advantages and disadvantages of the two languages, as well as a discussion of just when each language might be most useful.

The main body of the book is a series of 14 two-hour sessions, each of which illustrates and develops some experience with an important aspect of Pascal. After two introductory sessions on the mechanics of starting the system and entering programs into the editor, the first program (which prints out "How now brown cow") is entered, compiled and run. Every step involved in these processes is described in detail.

The next session uses the Apple sound system to illustrate the FOR statement, and subsequent sessions introduce procedures, functions, the graphics system, etc. These are followed by more advanced sessions on branching (IF and CASE), and WHILE loops are introduced in a session on string variables.

The last few sessions are devoted to some more advanced concepts and special aspects of Pascal—scalar data types, sets, arrays, records and files, and recursion. Here, too, the presentation is careful, the illustrative programs are relatively short and simple (but often rather interesting), and things are built up in a straightforward, logical manner that should be easy for the beginner to follow.

This book is not—and is not intended to be—a reference manual for Pascal programmers, and it does not attempt to cover some of the more advanced aspects of Pascal programming; more progress along those lines can be made using the Lewis book reviewed below. Things like Library Units, Segment Procedures, Exit, Memavail, External, Chainstuff, etc., required for longer and more complex procedures, are omitted, and some of the more useful graphics procedures such as WCHAR and WSTRING are not described. The rather confusing binary tree procedures and functions are not presented here. But even the omissions are very clearly listed (in Appendix C), so the reader knows exactly what he can look forward to learning as he gets farther into the system.

According to the introduction, the contents of this book have had a lot of testing and revision prior to publication, and the results of all this care are evident in the final product. Each session starts with a specific set of goals, proceeds through the stepwise development of a program which teaches the things needed to reach those goals, summarizes what has been covered and ends with a set of questions and problems which allow the reader to decide how well he understands the material just covered. An appendix contains suggested answers (in programming, there is no such thing as *THE ANSWER*) for all odd-numbered questions; perhaps the only thing one might want added to the book is some explanation of the answers. When all sessions are ended, there is a chapter entitled "Where Do You Go from Here?" which lists reference books.

The book ends with a useful series of appendices which detail the procedures to be used with single or dual disk drives as well as the usual lists of reserved words, built-ins, ASCII values, etc. Appendix H is a detailed listing of the specific changes in the book that would be required if it is used with Apple Pascal version 1.0 (rather than 1.1, for which the book is written). It is difficult to imagine anything a beginner might want to know about the Apple version of UCSD Pascal that has not been covered clearly and in detail in this outstanding book. Considering the amount of money required to obtain the hardware and software needed to run Apple Pascal, the $14.95 list price for the book is a tremendous bargain.

Although *Pascal Programming for the Apple* is also a bargain, it is definitely not for beginners. It's an excellent sequel to the *Hands-on Approach* for new Pascal programmers when they reach the stage at which more complex programs and advanced techniques are needed.

Lewis has done a great service to us intermediate Pascal programmers by demonstrating a number of ways to exploit the impressive potential of UCSD Pascal as implemented on the Apple II, and he enhances this contribution by comparing the advantages and disadvantages of a number of solutions to programming problems.

Lewis explains just what is going on in his programs; this makes them much easier to adapt to your own needs. Many of those programs can be really useful for a variety of Apple owners. For instance, Chapter 6 contains a very attractive general program that sets up a datafile (stored on diskette) which provides a screenful of instructions, prompts, blanks, etc. A subsequent program illustrates the use of this menu, and a third

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program demonstrates how the responses to the prompts can be retrieved from diskette for use in whatever data processing program you might have in mind. Perhaps this is old hat to experienced programmers, but it will certainly change the way I write my programs in the future.

Other example programs calculate mortgage interest, keep track of stock prices, analyze real estate cash flow, shuffle cards, etc. There is an excellent chapter on the use of library units, segment procedures and other techniques needed in very large programs. Much of this is not restricted to the Apple, so it could be useful to owners of other microcomputers for which UCSD Pascal has been implemented, and the final chapter evaluating the advantages and disadvantages of Pascal and Basic should be of interest to all microcomputer users. For Apple owners, there are several programs for the Pascal graphics and music systems; although none is very extensive, they all indicate some of the things that might be done with these features of the Apple. There are few if any errors in the printouts of these programs; all of them that I tested worked as soon as I eliminated my typos. The culmination of the book is a long (8½ pages) program which illustrates the use of a B-tree to form, index and access files. This powerful system illustrates some of the advanced aspects of Pascal which make the Apple II look increasingly attractive for business and scientific uses.

This last program also illustrates a weakness of the book. The prompts provided by the program are terse almost to the point of being uninterpretable. This seems to be a common problem with advanced programmers, who seem to forget that the program will be used by someone who probably has no idea of the difference between an index and a file, and he certainly doesn't know what name may have been entered on the disk the last time the program was run. Lewis provides enough information about the programs so a more user-friendly adaptation could be written rather readily, and I hope that the reader will keep the user in mind when writing the prompts for his own programs.

Another weakness is the coverage of string handling in Pascal. The impressive usefulness of the system as a text editor is ignored, and the possibility of using the Apple Pascal system to analyze and/or format text is not mentioned. There are even some errors in the description of programming with strings.

It's inevitable in such a rapidly moving area, but the book has already been attacked by that scourge of the computer industry, the voracious superseder. Although the point is not specifically stated, the book was obviously written for the Apple Pascal 1.0 version, so it necessarily omits features available in the 1.1 system currently being sold. This is particularly striking in the section on segments; the new system makes 15 (rather than seven) segments available to the programmer, and some of the compiler options are a bit different.

In spite of these minor weaknesses, I think that *Pascal Programming for the Apple* is an excellent and very useful addition to the library of anyone who wants to exploit the speed, convenience and awesome capacity which make the Apple Pascal system so attractive. The *Hands-On Approach* and *Pascal Programming for the Apple* provide a useful set which can guide a newcomer from the beginning to a rather sophisticated level of Pascal programming.

James R. Florini
Syracuse, NY

Beyond Games: Systems Software for Your 6502 Personal Computer

Ken Skier
Byte Books
Paperback, 200 pp., $14.95

You've seen the T-shirts with the bold proclamation: NOT PERFECT . . . BUT CLOSE. I kept thinking about that statement of self-assurance as I read Ken Skier's *Beyond Games*, an introduction to 6502 assemble-language programming.

Beyond Games is an excellent reference text because it includes tables, terms and programs that any assembly level programmer can use. The 6502 op codes are presented in several forms for reference and study: a mnemonic list, the instruction set in hex form with mnemonics, op codes by mnemonic and addressing mode and a chart showing instruction execution times.

There is also an ASCII character code list and a hexadecimal conversion table. Beyond these quick-reference listings, however, there are numerous assembly-language routines which a programmer can pull out to include in larger programs.

Beyond Games seems about evenly divided between instructional text and appendices. The two sections are interdependent, however. The author introduces a concept, provides a short example of how to use the idea, and then refers the reader to the appropriate appendix routine for a complete program. The assembler documentation included with each program in turn references the appropriate chapter for a detailed discussion of the material included in the listing.

Skier does a pretty good job of introducing the 6502 architecture and machine level concepts in general. Terms are defined in a readable, relaxed form with excellent diagrams. I like the way he introduces material as it is needed without lengthy introductions. The style is informal with many examples and questions. In every chapter there are many one-sentence rules, definitions and instructions which seem to stand out from the informal text. These rules are put to use in the sample programs, so I found it useful to underline them as I came across them.

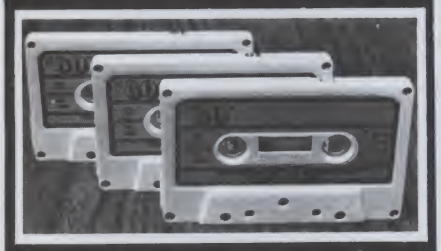
While *Beyond Games* is a useful reference text for anyone using the 6502 processor, PET, Apple, OSI or Atari users will especially like it for the numerous assembly routines that will install directly on these machines. The author's Visible Monitor program, for example, will be useful to anyone programming at the machine level, but especially so to the programmer without assembler/editor software for his computer. When properly implemented, the Visible Monitor will display a memory address, the contents of that location, a graphics representation of the value and the contents of the four 6502 registers. An up arrow below these fields points to the current field being accessed so the user may modify these locations. Some of today's microcomputers don't allow access to a machine-code monitor. Those that do frequently give only rudimentary information and have a cumbersome command structure. The Visible Monitor provided in *Beyond Games* should be a valuable programming tool for any 6502 machine-level programmer.

The major fault I find with Skier's approach is a lack of detailed information on using assembler software to produce the results in the book. Of course, each type of computer uses slightly different assembler protocol, but the 6502 MOS technology assembler seems to be the standard around which most are built. I think it would be appropriate, therefore, to include another appendix with assembler commands and error codes. Another chapter with instructions on loading the assembler software into each computer and saving programs onto tape would be welcome.

In general, there seems to be very little information on how to apply a new knowledge of assembly programming. While the author was careful to step the reader through learning the assembly mnemonics and what each routine does, he falls into the trap of assuming the computer user knows more than he probably does about accessing the hardware itself. Although chapter 13 does include information on entering the programs as Basic routines using DATA statements and some instructions on accessing each machine's ROM monitor, more detail would be welcome, especially if the user has limited machine experience.

I found only one error in the text. In discussing the OSI C1P computer, Skier observes that the USR routine will not pass a value from machine code back to Basic. In fact, OSI uses the ability to pass values between Basic and

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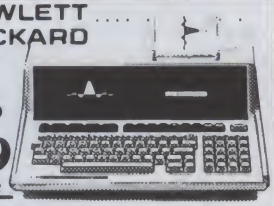
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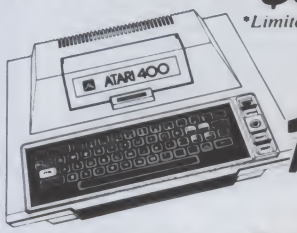
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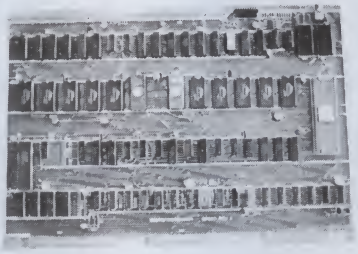
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machine code and back again in many of its own routines.

In his introduction, Skier says he designed the programs he presents to be useful, easy to use, readable, portable, compatible, expandable, compact and fast. Overall, I'd say he met his objectives pretty well. The text that supports his programs seems to fit these criteria also.

Beyond Games won't stand alone if you get really serious about programming at the machine and assembly level, but it is an excellent tutorial for the beginner and a useful reference work for the experienced. One thing's for sure; if you've never ventured past Basic, you'll find machine code a marvelous adventure. So, as Skier asseverates in his introduction, "Read. Program. Enjoy!"

Tom Badgett
Bluefield, WV

How to Get Started With CP/M

Carl Townsend
dilithium Press, 1981
Paperback, 140 pp., $9.95

I thought this book would be just what the doctor ordered for the novice programmer who can't fathom the complexities of the CP/M manuals. But the contents do not live up to the title's promise.

In half of the ten chapters, Townsend offers a sketchy overview of the CP/M operating system. The balance of the book covers the definition of an operating system, hardware in a typical microcomputer system, care of floppy disks, word processing, spoolers and high level languages available for CP/M. The last 42 pages are appendices.

"Your First CP/M Session," chapter 4, takes you gently by the hand from loading your new CP/M master diskette through making two copies. The instructions assume that you have two disk drives and that your blank disks have already been formatted. Obviously, this may not be the case. Control codes are described with little more information than that furnished in the single liners of the CP/M manuals.

After a brief introduction to file names and wild card references, the next chapter gives a few paragraphs of explanation for each of the built-in commands: DIR (directory), ERA(erase), REN(rename), SAVE and TYPE(output to screen). The USER command added by version 2.0 of CP/M isn't mentioned.

An entire chapter is devoted to the CP/M editor. You are given a fair idea of what is involved in the basic creation and modification of a text file. The PIP (copy and transfer functions), STAT (disk and file status) and DUMP (hexadecimal listing) utilities are quickly surveyed. PIP special control functions are listed with a summary of the CP/M manual description of each function.

Appendix A is a useful summary of the CP/M memory map, built-in commands and utilities, control codes, editor and PIP commands. The other appendices include lists of suppliers of hardware for which CP/M is available, vendors of CP/M-compatible software of various types, a glossary, list of titles for the first 33 volumes of the CP/M User's Group software (there are now in excess of 50 volumes with information on programs on each disk available from CPMUG) and simple diagnostic information for a few common problems which may occur in using CP/M.

This book might be helpful to a potential purchaser who needs to know what a disk operating system is. A general idea of the major features of CP/M as a file handling system and how it works is given. But if you really want to get started *using* CP/M, you'll be much better off spending your money on one of the programmed learning guides. These guides are usually more complete and enable you to get hands-on experience in working through the various nuances of CP/M.

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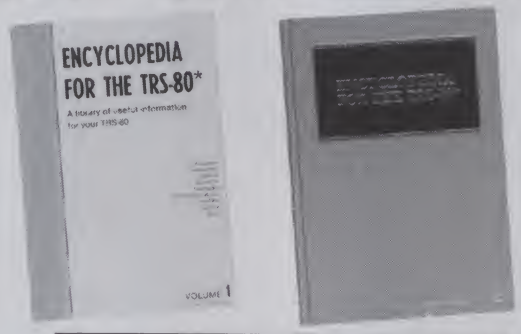
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Edited by Linda Stephenson

Sanyo Is Running with CP/M
Computer Access for the Handicapped
Add-Ons for IBM PC

Versatile Business Micros

Sanyo Business Systems Corp., 51 Joseph St., Moonachie, NJ 07074, has introduced three new desktop computers. All are supplied with CP/M, Sanyo-Basic, diagnostics and utilities. All have graphics capability, detachable keyboard, number pad, programmable function keys and a video display.

The FDS-1000 includes one floppy disk drive and can run with three additional drives. It is built around a Z-80A microprocessor. Price is $1995.

The MBC-2000, priced at $3495, includes two 328K-byte drives with capacity for two additional drives for a total of 1.3M bytes. The MBC-3000 offers two 1M-byte drives with add-on capacity for a total of 4M bytes; price is $6495. Both MBC-2000 and MBC-3000 use the 8085A microprocessor chip. Reader Service number 464.

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Cuesta Systems, Inc., 3440 Roberto Court, San Luis Obispo, CA 93401. Reader Service number 465.

Communication Tool Provides Computer Input

The Omni communications system is available from Communications Research Corp., 1720 130th Ave. N.E., Bellevue, WA 98005. Omni is a fully portable communication aid for the non-vocal or vocally impaired severely handicapped person, and a computer keyboard substitute for people with impaired dexterity. The Omni system includes a display board, LCD readout, hard copy printout, 16K programmable memory, remote environmental control, audible alarm, voice synthesizer, typewriter interface and computer access. The display board communicates selected messages in the form of printed words, phrases, symbols or pictures. Environmental control enables the user to turn on and off electrical equipment. The emergency alarm will automatically sound if the switching device is held in an open position. An RS-232 port allows interfacing with micro-



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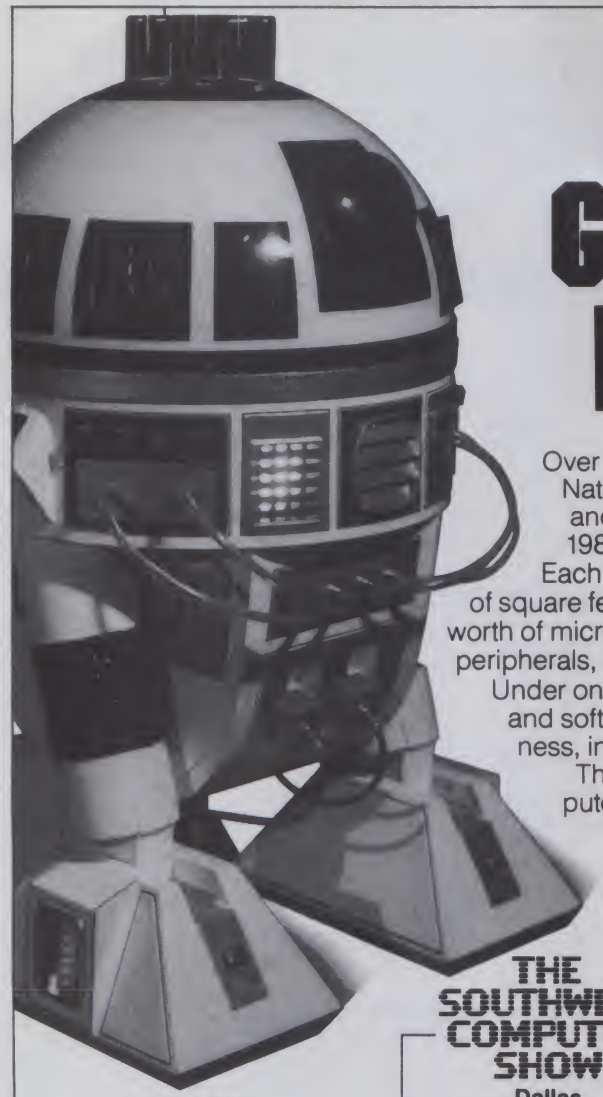
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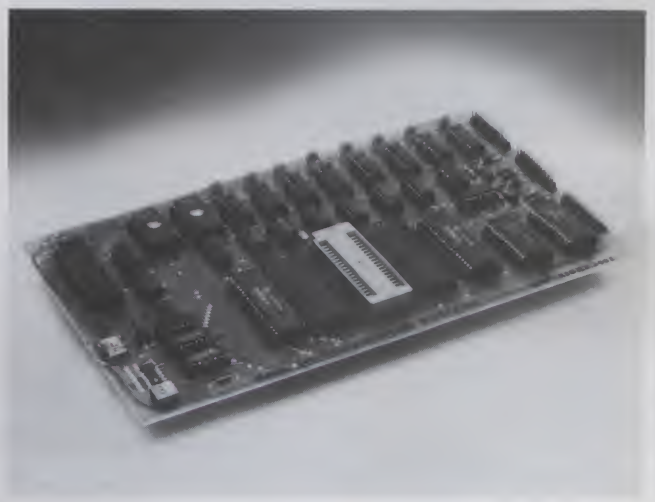
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P&E Microcomputer Systems, PO Box 2044, Woburn, MA 01888. Reader Service number 468.

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P&E EPROM/PROM Programmer.





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Road, Colorado Springs, CO 80919, produces ultrahigh-density floppy disks for the new drive technology. The disks are manufactured using a spin-coating technique similar to that used for rigid disk media. Brown's UHR I disk provides 150–200 track-per-inch recording capability, for use with the Amlyn Corp.'s high-capacity drives. The VHR I floppy disk provides 96 tpi data storage. Sample disks are $10 each. Reader Service number 471.

Amlyn Corp., 1758-H Junction Ave., San Jose, CA 95112, offers 5¼-inch floppy disk drives that employ an Intel 8051 microprocessor and a unique disk cartridge to provide up to 8M bytes of data storage. The cartridge holds five spin-coated high-resolution disks; an articulating selector device removes the addressed disk and loads it on the drive spindle. Users can easily change an entire cartridge or individual disks. The Amlyn 5850 is functionally compatible with controllers that interface to the Shugart SA850 double-sided, double-density Maxi-Drive; the model A506 is compatible with controllers that interface to the Seagate Technology ST506 Winchester drive. The new MiniPac drives are designed for backup of small- to medium-sized hard disks and for on-line use. Price for the Amlyn 5850 is $1250; the Model A506 is $1280. Reader Service number 470.

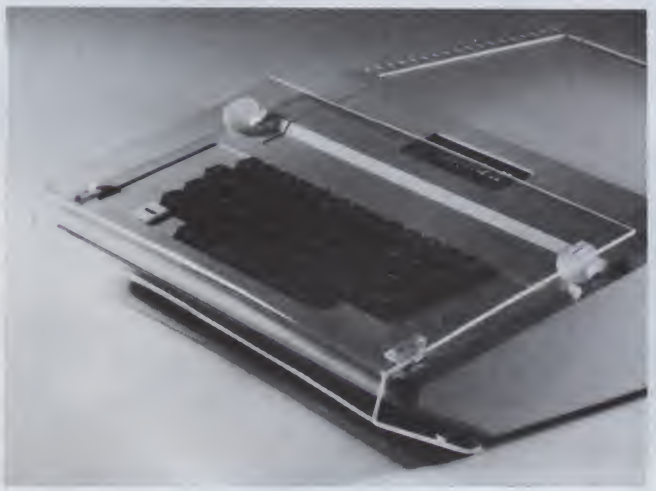
Protect Your Keyboard

The Plexa-lok clear acrylic cover slips up and over the Apple II keyboard and then gently snaps into position. It protects the keyboard from dust and spills when the computer is not in use, and lets you leave the power on for extended periods without affecting air circulation—you can take a break without worry about visitors accidentally destroying hours of work. Price is $19.95.

Last Electronics, PO Box 1300, San Andreas, CA 95249. Reader Service number 469.

Micro-Sci Offers Alternative to Apple Disk II

Micro-Sci's model A2 5¼-inch drive is fully compatible with the Apple II controller. The A2 can also be purchased with a Micro-Sci A2 controller to provide a complete A2 subsystem. Any combination of A2s and Disk IIs with either type of controller will run, providing full system-level compatibility at lower cost. Software support



The Plexa-lok cover from Last Electronics.



Micro-Sci's A2 floppy disk drive.

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*CP/M is a trademark of Digital Research

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ISO-1


ISO-2

Pat. #4,259,705

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- **SUPER ISOLATOR (ISO-3) similar to ISO-1 except double isolation & Suppression $104.95**
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- **MAGNUM ISOLATOR (ISO-17) 4 Quad Isolated sockets; For ULTRA-SENSITIVE Systems $181.95**
- **CIRCUIT BREAKER, any model (Add-CB) ..... Add $9.00**
- **CKT BRKR/SWITCH/PILOT (-CBS) ..... Add $17.00**

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Tecmar's PC-Mate expansion chassis is styled to match the IBM Personal Computer

Expansion Options for IBM PC

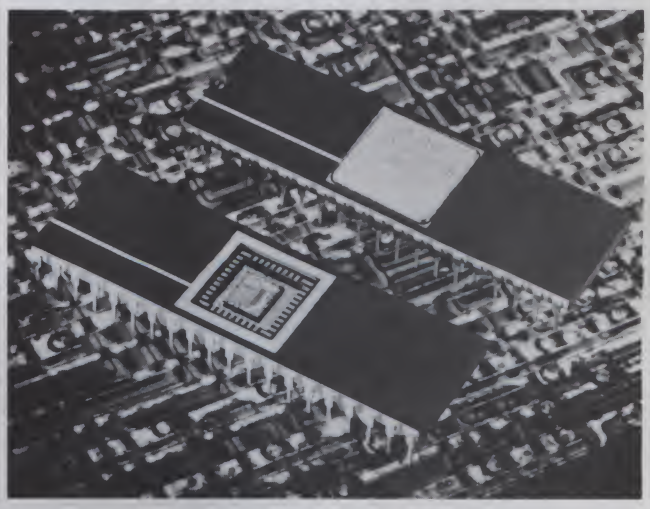
PC-Mate, a product line of more than 20 options for the IBM Personal Computer, is currently available from Tecmar, Inc., 23600 Mercantile Road, Cleveland, OH 44122. The line includes an expansion chassis, Winchester disk, 64/128/192/256K byte RAM cards, system clock/calendar with battery backup, digital-to-analog and analog-to-digital converters, voice synthesizer and other devices. Reader Service number 478.

includes compatibility with DOS 3.2, DOS 3.3, Pascal and CP/M. Micro-Sci's A2 with controller is priced at $579, without controller $479.

Micro-Sci, 17742 Irvine Blvd., Suite 205, Tustin, CA 92680. Reader Service number 474.

Micro/Mini

Digital Equipment Corp., Maynard, MA 01754, has announced the first of a series of chip-level PDP-11 microprocessors for use in personal computers. The Micro/T-11 chip is a 16-bit microprocessor with a base-level PDP-11 instruction set; it can be operated with various industry standard devices with



The Micro/T-11 microprocessor from Digital is shown with a magnified view of its internal circuits.



MultiTech Systems' MT500 microcomputer system.

a user-selectable 16- or eight-bit data bus. Application programs can be developed for Micro/T-11 on the PDP-11 minicomputer or on microcomputer systems using Macro 11 assembly language. Programmers familiar with PDP-11 programming at the assembly level can generate programs for Micro/T-11 without specialized training. Reader Service number 477.

New Micro with CP/M

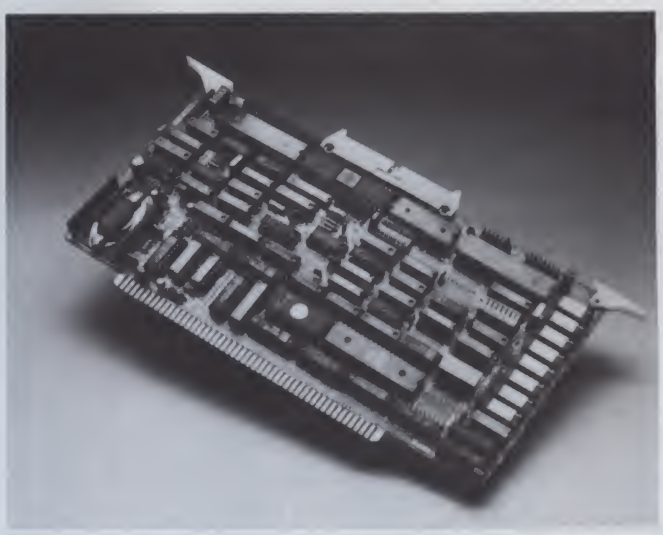
The MT500 provides both data and word processing for business and scientific applications. This Z-80A-based computer features 64K bytes of RAM, two integral 5¼-inch floppy disk drives and Winchester hard disk storage of 5M bytes. Video display and S-100 expansion are built in. Options include letter quality or high speed printers and 103- or 212A-compatible modems. Prices range from $4795 to $7995, depending on storage options.

Multi-Tech Systems, Inc., 82 Second Ave. S.E., New Brighton, MN 55112. Reader Service number 479.

RAM-Pack Micro

Casio's new FX-9000P personal computer features full 67-key keyboard and CRT built into a compact unit. A separate numeric keypad and mathematical functions including standard deviation, regression analysis and correlation coefficient provide convenience in statistical management. High-resolution graphics simplify analysis of experimental results and business data. The FX-9000P can be expanded up to 32K bytes of user memory. The basic unit comes with one 4K slot-in RAM pack. Price is $1199.

Casio, Inc., 15 Gardner Road, Fairfield, NJ 07006. Reader Service number 481.



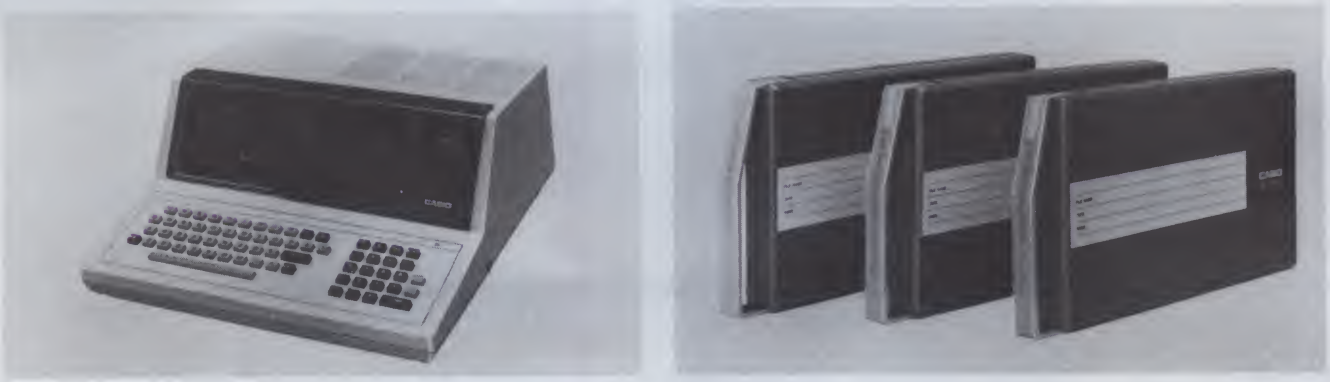
Super/Net S-100 board from Advanced Micro Digital Corp.

Complete System on A Single S-100 Board

An S-100 single board computer has been introduced by Advanced Micro Digital Corp., 7201 Garden Grove Blvd., Suite E, Garden Grove, CA 92641. Super/Net has 64K bytes of bank-select dynamic RAM, a Z-80A CPU, a 2716 2K monitor EPROM, 5¼-and eight-inch floppy disk controller, two serial and two parallel interface ports and a Z-80A CTC for real-time interrupts; full DMA operation is supported. Super/Net meets IEEE-696 specifications and operates under both CP/M and MP/M software. The single-board design requires less power and costs less to produce than the traditional four-board S-100 design; it allows the addition of more user-defined options at a lower cost. It can also be used as a bus master in a multi-user system. Price is $1125. Reader Service number 480.

Three in a Row

Centronics Data Computer Corp., Hudson, NH 03051, offers the Printstation 350 series



The Casio FX-9000P microcomputer provides on-line storage in 4K-byte RAM cartridges.

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• AP104

• AP101	Apple II with Single Disk Drive	$109
• AP102	Apple II with Double Disk Drives	119
• AP103	Apple II, 9 inch Monitor & Double Drives ..	129
• AP104	Apple ///, two additional Drives & Silentype	139
• AP105	12 inch monitor plus accessories	99
• RS201	TRS-80 Model I, Expansion Unit & Drives ..	109
• RS202	TRS-80 Monitor or TV set	84
• RS204	TRS-80 Model III	129
• RS205	Radio Shack Color Computer	89
• AT301	Atari Computer & Accessories	109
• P401	Paper Tiger 440/445/460	99
• P402	Centronics 730/737 Line Printer II/IV	89
• P403	Epson MX70 or MX80	89
• P404	Epson MX100	99
• CC90	Matching Attaché Case	75

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5650 INDIAN MOUND CT. COLUMBUS, OHIO 43213 (614) 868-9464



Centronics Printstation 350.

of industrial-grade matrix printers. All models handle cut-sheet, fan-fold and tear-off forms. Eight resident character sets and 110/200 V operation permit international use of these printers. Pin-addressable graphics, 200 cps print speed, self-test diagnostics and bidirectional logic-seeking printing are included. The Printstation 350 was designed to be customized for special needs. The Printstation 352 provides data-processing quality printing and is priced at $1795. The Printstation 353, which can also provide high-resolution word processing with multipass functioning, is $2495. Reader Service number 482.

IAS and CP/M™

Our Integrated Accounting System (IAS) has always been a good value, but wait until you see the latest version. And, it's now available for the CP/M™ operating system, too. Some of the features include:

Custom Chart of Accounts with a more flexible numbering system and 25 character account names. Improved financial reports, including an Income Statement with percent-of-sales figures. An expanded and more flexible check register. Expanded account names in AR and AP. AR incorporates a modified open-item, balance-forward account system with invoicing and statements. AP has a more flexible check writing program as does the PR subsystem. The GL, AP and PR check writing programs all are formatted for the same NEBS checks so you don't need three different types of checks. The AR invoicing and statement programs are also formatted for NEBS forms. All programs use our exclusive Skip-Sequential file structure for improved speed and disk efficiency. The user's manual has been expanded and includes sample printouts from most programs, and is written for the non-programmer.

The General Ledger is $150.00 and may be used as a stand-alone system. The AR, AP and PR subsystems require the GL subsystem for proper operation. GL plus one subsystem is $250.00; GL plus two subsystems is $325.00 and the complete package is $395.00. NOTE: the new IAS requires a 24 × 80 cursor-addressable terminal, 48K of memory and one 8" or two 5¼" disk drives. CP/M™ users must have the SoHo Group's Matchmaker, which we will provide free to the first 100 buyers of the complete IAS package ($110.00 value). Matchmaker may otherwise be ordered with any IAS subsystem for $75.00.

The IAS operator's manual may be purchased for $25.00 (credited towards purchase). Please specify 8" SD (soft sectored) or 5¼" North Star disk and CRT type when ordering.

CP/M is a registered trademark of Digital Research.

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CRT CONTROLLER



This intelligent CRT Controller uses an 8085A CPU & an 8275 Integrated CRT Controller. It features:

- 25 lines (80 char./line)
- 5x7 dot matrix
- Upper & lower case
- Two 2716's (controller & char. generator)
- Serial interface RS232 & TTL
- Baud rates of 110, 150, 300, 600, 1200, 2400, 4800 and 9600
- Keyboard scanning system
- Unencoded keyboard required
- Uses +5V & ±12V Power Supplies
- Does not have graphic capabilities.

Documentation includes program listing and composite video circuit.

Bare Board only (with doc) **$39.95**
2716 Char. Gen. A7 **$19.95**
2716 Program A12 **$19.95**

A-D CONVERTER



JBEs 16 channel A-D Converter plugs into your Apple II computer. It uses an ADC0817 which incorporates a 16 channel multiplexer and an 8 bit A-D Converter. The 16 inputs are high impedance and the voltage range is 0 to 5.12 volts. Conversion time is <100 μsec. The resolution is 8 bits or 256 steps, linearity is ± 1/2 step. Two 16 pin DIP sockets are used for input, GND & reference voltage connections. There are 3 single bit TTL inputs. Doc. includes sample program.

81-132A Assm. **$89.95**
81-132K Kit **$69.95**
81-132B Bare Board **$29.95**

EPROM PROGRAMMER



JBE's EPROM Programmer is designed to program 5V 2516's, 2532's & 2716's. It interfaces to the JBE Parallel I/O card using four ribbon cables. An LED indicates when the EPROM is being programmed. A textool zero insertion force socket is used for the EPROM. Comes with complete documentation for writing and reading EPROM's in the Apple II or Apple II Plus. Cables available separately.

80-244A Assm. **$49.95**
80-244K Kit **$39.95**
80-244B Bare Board **$24.95**

PARTS

6502 MPU	**$9.95**
6522 VIA	**$9.95**
Z-80 MPU	**$9.95**
Z-80 PIO	**$9.95**
TWO 2114 RAM	**$9.95**
2716	**$14.95**
50 pin conn.	**$5.95**
Dip Jumper 2 ft.	**$4.95**

6522 APPLE II INTERFACE



The JBE 6522 Parallel Interface for the Apple II Computer, plugs directly into any slot 1 through 7 in the Apple. This card has 2 6522 VIA's that provide:

- Four 8 bit bi-directional I/O ports
- Four 16 bit programmable timer/counters
- Serial shift registers
- Handshaking

A 74LS05 is for timing. Four 16 pin sockets provide easy connections to other peripheral devices. (Dip jumpers with ribbon cables are also available from JBE) The 6522 Parallel I/O card interfaces to the JBE EPROM programmer. Understanding of machine language required to use this board. Inputs and outputs are TTL compatible.

79-295A **$69.95** Assembled
79-295K **$59.95** Kit
79-295B **$19.95** Bareboard

SPEECH SYNTHESIZERS



JBEs Speech Synthesizers use the Votrax SC-01 Phoneme Synthesizer chip. The SC-01 phonetically synthesizes continuous speech of unlimited vocabulary. The SC-01 contains 64 different phonemes and 4 levels of inflection accessed by an 8 bit code. It requires 10 Bytes per second for continuous speech. Both boards have an audio amp for direct connection to an 8 ohm speaker.

Documentation includes basic user programs, a phoneme chart and listing of coded words to help you get started. Documentation for the Apple II® Speech Synthesizer includes a disk with many user programs.

81-088 Apple II Speech Synthesizer **$139.95**
81-120 Parallel Input Speech Synthesizer **$149.95**

Prices include the SC-01 Chip
SC-01 sold separately for **$ 75.95**

EPROM EXPANSION CARD



JBE EPROM Expander for the Apple II holds six 5V 2716s for a total of 12K bytes of EPROM. This board takes the place of the on board ROM in the Apple. It is software switchable by the same technique used by the Apple II firmware card. Solder jumpers are for reset to the Apple ROM or EPROM Expansion Card. Use JBE EPROM Programmer and Parallel I/O to program your EPROMs. EPROMs sold separately.

81-085A Assm. **$59.95**
81-085K Kit **$49.95**
81-085B Bare Board **$39.95**

81-260 "SLIM"



Single board large scale integration Microcomputer. This 4.5 x 6.5 board uses the 6502 Microprocessor, two 6522 VIA's, four 2114 RAM's, 2516, 2716 or 2532 EPROM. The fully buffered 22/44 pin bus is similar to the KIM® , SYM® , and AIM® expansion connector. The four 8 bit I/O ports connect through 16 pin dip sockets. This board was designed for control and is ideal for Personal and OEM use.

- 6502 MPU
- Two 6522 VIA's
- Four 2114 RAM's (2K bytes)
- One EPROM 2516 or 2532
- Crystal clock 1 Mhz
- Requires 5V 1AMP Power
- 4.5 x 6.5 card
- Power on reset
- Fully buffered-expandable
- Solder mask-both sides

Use your Apple II Computer, JBE 6522 Parallel Interface card and EPROM Programmer as a development system for SLIM.

Prices:
81-260A **$199.95** Assembled
81-260K **$149.95** Kit
81-260B **$ 39.95** Bare Board

6502 MICROCOMPUTER

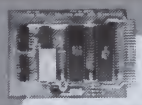


6502 MPU, 6522 VIA, 2716 EPROM, 2114 RAM single board computer. Single 5 volt power supply at 400 Ma. Two independent 8 bit I/O ports with handshake lines. RC controlled 1 Mhz clock.

Complete documentation. I/O lines use 50 pin edge connector. Data and address lines are not accessible. Mod. for 2532 is included. EPROM is not included. 1K RAM, 2K EPROM, 2 I/O ports.

80-153 Assm. **$110.95**
80-153 Kit **$ 89.95**
80-153 Bare Board **$ 19.95**

Z-80 MICROCOMUTER

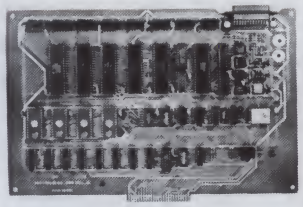


Z-80 MPU, Z-80 PIO, 2716 EPROM, 2114 RAM single board computer. Single 5 volt power supply at 300 Ma. Two independent 8 bit I/O ports with handshake lines. RC controlled 2Mhz clock.

Complete documentation. I/O lines use 50 pin edge connector. Data and address lines are not accessible. Mod. for 2532 is included. EPROM is not included. 1K RAM, 2K EPROM, 2 I/O ports.

80-280 Assm. **$129.95**
80-280 Kit **$119.95**
80-280 Bare Board **$ 19.95**

JBE I MICROCOMPUTER



JBE's 7.75 x 11.75 6502 base Microcomputer has the capacity for 16K of EPROM, 4K of RAM, 8 Parallel Ports and 1 Serial Port. Monitor and Tiny Basic are also available. The fully populated version includes:

- 1 6502 CPU
- 4 6522 VIA (8 Parallel I/O Ports)
- 1 AY5-1013 (Serial I/O Ports)
- 8 2114 RAM (4K)
- 2 2716 EPROM (Monitor & Tiny Basic)

The partially populated version includes:

- 1 6502 CPU
- 1 6522 VIA (2 Parallel I/O Ports)
- 1 AY5-1013 (Serial I/O Port)
- 2 2114 RAM (1K)
- 1 2716 EPROM (with Monitor)

Both versions include sockets for 2716s or 2532s, 8 16 pin sockets for I/O interfacing and a DB25 connector for RS232.

All address and data lines are brought off the board to the 50 pin edge connector. (similar to the Apple II bus)

This board also features power on reset and cassette interface.

81-030 C Fully Populated **$349.95**
81-030M Partially Populated **$249.95**
81-030B Bare Board **$ 89.95**
2716 EPROM (with Monitor) **$ 19.95**
2715 EPROM (with Tiny Basic **$ 19.95**

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Edited by Linda Stephenson

Apple Programmers Have a New Tool
Software for IBM Gets Personal

Cobol Reprogramming Tool

Even a nonprogrammer equipped with CRT! can produce error-free RM/Cobol source programs. CRT! lets you use your computer to program itself, thus speeding generation of bug-free lines. It lets you standardize the code, thus reducing documentation and maintenance costs. CRT! will generate complete RM/Cobol source programs that present data entry screens, allow data entry with extensive input editing, update (or inquire into) files from the data entered and print simple or complex reports. Data dictionaries of files, records and fields are built and maintained by the system, allowing quick and easy modification. CRT! is priced at $1500 for CP/M, MP/M and Oasis systems; MOasis and Unix versions cost $2000 and $2500 respectively.

Communication Arts, 2120 Main St., Suite 250B, Huntington Beach, CA 92648. Reader Service number 483.

Apple Programming Aid

The Tool, for the Apple II, is designed to save programmers 80 to 90 percent of development time. Designing attractive entry screens, validating, formatting and storing user input and providing the user with efficient screen editing take up most of a programmer's time and the computer's memory. The Tool streamlines these repetitive aspects of Basic programming. Price is $395.

High Technology Software Products, Inc., PO Box 14665, 2201 N.E. 63rd St., Oklahoma City, OK 73113. Reader Service number 484.

Pascal for CBM

Commodore Business Machines, Inc., 681 Moore Road, King of Prussia, PA 19406, is offering UCSD Pascal Version IV.0 (P-System) for its CBM microcomputers. This updated version of Pascal increases storage efficiency of program segments and provides compatibility with all other UCSD users. Program units can be linked dynamically at run time rather than prior to running. Version IV.0 also features a debugger. The P-System supports CBM model 8032 with a 64K RAM card, model 4040 and 8050 disk drives and IEEE and serial printers. Priced at $175. Reader Service number 485.

Professional Package

Educational Computing Systems, 106 Fairbanks Road, Oak Ridge, TN 37830, announces the Omniware line of software for Apple II with Applesoft, 48K RAM and DOS 3.3. Omnifile is a full-featured file manager and report generator; price is $49.95. Omnitrend, a powerful multiple regression trend analysis program with statistical calculations and extensive high-resolution graphics is priced at $44.95. Omnigraph, a flexible data plotting program that allows X-Y plots, bar charts and pie charts, costs $39.95. All three are available as Omnipack for $99.95. Program disk includes listable code. Reader Service number 486.

Apple Corps Bomber

They told you your mission would be easy—just drop in on the Flatlanders with your supersonic jet and clear away a few radar and ICBM installations. But maybe they didn't warn you about the supersonic tanks, heat-seeking missiles, explosive balloons, enemy jets and fuel-guzzling bluebirds you'd have to face. Bluebirds? Starblazer puts you at the controls of a maneuverable fighter bomber charged with five different missions that will put your attack and evasion skills to the test. Uses joystick or keyboard control, and requires 48K Apple II, 13- or 16-sector. Price is $31.95.

Broderbund Software, Inc., Entertainment Software Division, 1938 Fourth St., San Rafael, CA 94901. Reader Service number 487.

Failsafe

With an IBM Personal Computer and a newly released software package from Metamorphics, Inc., you can now keep records of your possessions updated and cross-referenced electronically. Household Inventory will track up to 100 items in each of 25 defined rooms of your home. Just key in your effects, including serial numbers, value, date of purchase and other pertinent information, and in case of loss you'll have ready access to a detailed printout for your insurance company. But remember to store the floppy disk off the premises—in case of fire, you'll have trouble reconstructing melted data. Price is $95.

Metamorphics, Inc., 154 Montgomery Ave., Bala Cynwyd, PA 19004. Reader Service number 488.

Ringing Up Savings

PhoneSaver is an easy to use database management system designed to cut the cost of long-distance phone calls. Phone numbers that are not pre-authorized will show up at the end of each month on a report of unauthorized phone calls. Authorized numbers are summarized by name, address and authorization department. Client coding can also be used by professional offices to more effectively control reimbursable charge calls. PhoneSaver is now available for CP/M systems and CBasic2. Price is $75.

Digital Systems, Inc., 680 Lafayette Road, Hampton, NH 03842. Reader Service number 489.

It's No Joke!

Perhaps you thought a database program for jokes and stories was too much to expect? Well, TexaSoft, 1028 North Madison Ave., Dallas, TX 75208, brings you Micro-Joke to fulfill that very need. Micro-Joke comes with over 50 jokes already on file. You can store and retrieve your own favorites by keyword, number or random chance. And for a truly trivial database—Micro-Trivia comes with 50 entries on file and room for more. You need never forget those totally insignificant facts again. Both programs are available for TRS-80 and IBM Personal Computer and cost $29.95. Reader Service number 475.

IBM PC Package

The Mail Manager, a professional mailing system for the IBM Personal Computer, will create and update name and address files, create subfiles,

merge files, sort by name or zip, select records and print mailing labels, envelopes and lists. The Mail Manager costs $49.

Starware, Suite 802, 1701 K St. N.W., Washington, DC 20006. Reader Service number 490.

Super CP/M

Systems Group, 1601 Orangewood Ave., Orange, CA 92668, has significantly increased CP/M speed, simplified its use by programmers and users, and added an extensive error management scheme and utility programs. Super CP/M is bootable from any drive, including hard disk and tape drives; once a system is brought up the user no longer needs the system disk, even for warm boots. A loader determines memory size and builds the largest system allowed. The new CP/M uses 1K-byte sector sizes, increasing throughput speed up to fourfold. Super CP/M costs $190. Reader Service number 491.

Tending the Flock

Custom Data, 1100 New York Ave., PO Box 1066, Alamogordo, NM 88310, announces completion of its TRS-80 Church Donations package, for reporting and recording contributions from the congregation. The Model III version now available requires two disk drives and 48K bytes of random-access memory. It will service a congregation of up to 1200, with 10 user-selectable categories of donations. Price is $125.

Two complementary programs are also offered. Church Directory uses a select code to alphabetically list members of up to five identifying divisions. Price is $35. An attendance record that can keep track of 160 functions for up to 3000 people also costs $35. Reader Service number 492.

CP/M File Transfer

Transfer is a utility to link one CP/M system to another CP/M system that is also equipped with Transfer. The software lets you transfer files at full data speed (no conversion to hex), with CRC block control check for reliable error detection and interactive retry. It has full wildcard capability—the sender just needs to specify a wildcard filename and the receiver specifies the destination disk. The file control block for each individual file is automatically transferred from the sender to the receiver. The 8080 source code is included for your convenience should your system configuration change. Price is $179.

Starr Computer Systems, Inc., 6126 Melissa Lane, Omaha, NE 68152. Reader Service number 493.

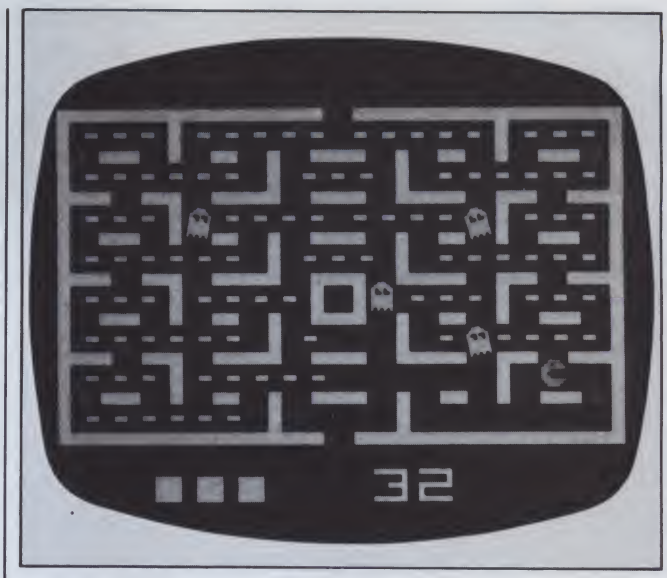
Stock Market Update

The Personal Investor connects your Apple II with the Dow Jones News and Quotes Service to update a portfolio and retrieve business news. The portfolio generates four reports, which include information on gains/losses for individual stocks and total portfolio, profits/losses for each sale of stock, dividend yields on purchase and current price, and dividend date. Sales and purchase expenses such as commissions are accounted for. Stock splits are calculated automatically. Quotations include bid, ask, yesterday's close, today's open, high, low, last price, volume and current dividend yield; net change from yesterday's close to last price is also reported. The Personal Investor costs $95.

PBL Corp., 605 Harmony Circle Drive, Wayzata, MN 55391. Reader Service number 494.

Apple Speedup Enhancement

Stellation Two, PO Box 2342, Santa Barbara, CA 93120, has announced Spooler, a new software product for users of the Pascal Speedup Kit in Apple II microcomputers. This timesaving program lets you continue to use the system while data is being printed. The user executes Spooler, which then prompts him for the name of a text file on disk and the unit number of his printer. A separate task is then launched to begin the transfer, and control is returned to the user. Spooler works in any slot, with any printer. It is priced at $45. Reader Service number 496.



Pac-Man by Atari

Pascal for Z-80 Micros

Alcor Systems offers a Pascal Compiler that runs on TRS-80 Models I and III and Z-80-based CP/M systems. Alcor Pascal is a complete implementation of Jensen and Wirth standard Pascal, with over 20 language extensions. Alcor Pascal can compile large programs using limited memory (4000+ lines in 48K bytes). A full screen text editor is included. The Compiler is $199; Advanced Development Package with p-code optimizer and native code generator is $125.

Alcor Systems, 13534 Preston Road, Suite 365, Dallas TX 75240. Reader Service number 497.

Just for Fun

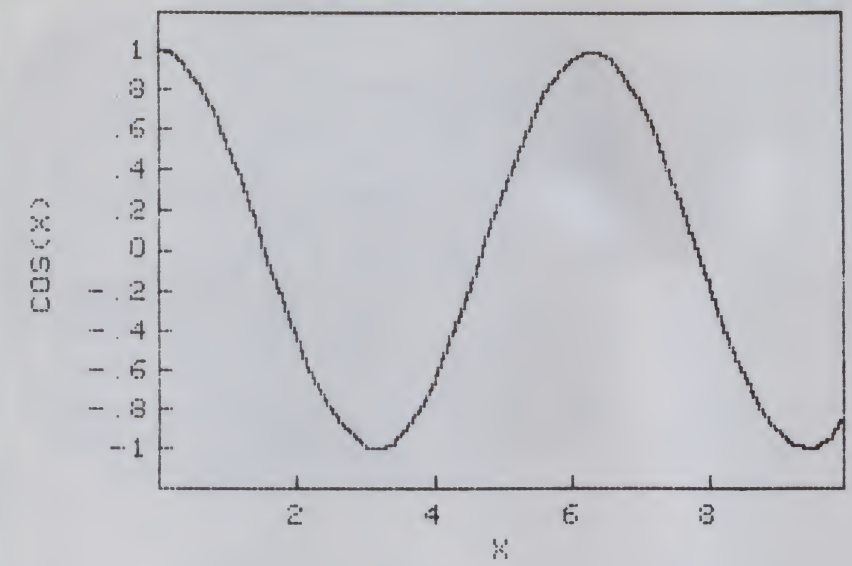
Three new game programs have been released by the Home Computer Division of Atari, Inc., 1265 Borregas Ave., PO Box 427, Sunnyvale, CA 94086. Pac-Man is the Atari version of a popular arcade game—in this version, a player's character must negotiate a maze without being eaten by any of four pursuers. Eating an energy dot gives the player's character ability to attack and gobble up the pursuers.

The Centipede player uses a Bug Blaster to annihilate colorful legions of spiders, fleas, scorpions and poisonous mushrooms—and the centipede itself. Both games are priced at $44.95.

Caverns of Mars takes players beneath the surface of Mars. The player's character must penetrate several layers of defenses to reach the Alien's stronghold. Floating mines, enemy ships on patrol and deadly laser fire pose a constant menace. This game costs $39.95. Reader Service number 495.

Project Tracking

Micro Associates, Inc., 2300 Highway 365, Box 131, Nederland, TX 77627, offers a project tracking and management system for microcomputers with CP/M and Microsoft Basic. DWGLIST is designed to help engineers and contractors develop and maintain drawing indexes. The program allows quick reference to the latest drawing revisions to ensure that the latest designs are being followed. It keeps track of drawings to avoid duplication. And it will produce a master drawing index or project drawing index on command. DWGLIST costs $350. Reader Service number 499.



Sample 2.

(continued from p. 210)

Spotter will let you set the high and/or low points for the graph (it'll do this automatically, based on the data itself, too), the starting date for the data, and will even let you move information back and forth in time, so to speak, so that you could compare 1981 sales and 1980 sales month-by-month on the screen.

Trend-Spotter will work with either a single- or dual-drive Apple II Plus 48K system. You start the program with the Trend-Spotter disk in your main drive when you turn the system on.

It's quick and easy to set up data files. The only problem I found with the filing system is that once you have a file saved, you can't change the title of that file. It's easy to add or change the data in the file, but if you start with a file called Electricity (for your electric bill every month), and then want to shorten it to Elec to save time each time you use this file, you can't do it.

The numbers go in easily and fast (once you set a starting date, Trend-Spotter will automatically know the next date to ask you for). Each file can hold up to 100 points of information, which means on a monthly basis you can store more than eight years of data in a single file.

The latest version of Trend-Spotter will allow you to use and display VisiCalc files, too, if your information is already in that format.

And, yes, you can get hard copy of any file, for your records.

As noted, once you have the data saved, you use the Display program to show the information in whatever format you want. A simple line graph for 1981 sales? You type LINE SALES 1981. How about a bar graph for your utility costs, say, for that Electricity file? Simply type BAR ELECTRICITY.

It really is that easy.

Even something different is simple. How about a line graph for sales and an area graph for the cost of materials? Type LINE SALES 1981 and AREA MATERIALS 1981 and it's there on your screen.

Trend-Spotter uses four work files so you can have the data from four files available in memory at one time; you don't have to load them from your data disk each time you want to change the graph. You can also add one file to another (remember the example of adding up all your utility costs?), or multiply one file by another, or subtract one from another, and then display the results as you wish.

You can even add an inflation rate (or a deflation rate, if you're so inclined) to see what the data would look like at a 12 percent (or whatever) rate of change. Think of how helpful it might be to display a graph showing your 1981 sales, with another line in a different color showing what those sales would look like at an 8 percent inflation rate, and perhaps another line showing what they'd be if they were down 5 percent.

Trend-Spotter uses a Sum command to add up data points, to display whatever type of graph you want as a cumulative total for the information.

But what if the data you have for one set of information is quarterly, while another is monthly, and another is bimonthly? Not to worry—Trend-Spotter can convert your data from one form (quarterly, for instance) to another. This makes it easy to compare data that you have in different forms, all on the same graphic scale.

All information from your data entries is saved in the form of text files on the data disk. Trend-Spotter has a way to make things a little easier for you if, for instance, you need to make a graphic presentation. You can construct the picture on your video screen, using different colors, different types of graphs, etc., until the data is shown just as you want it—and then will save this "picture" as a binary file on the disk. This lets you load the entire display at one time, just as it was when you finished with it. So, to display this picture in the future, you don't even need to load in the various files you used to make the graph—you just load the display with one command.

And if you have a question, type HELP and all the commands, with a brief explanation of each, are displayed for you.

Trend-Spotter is a terrific aid for any businessman who wants to see not only where his business has been but also where it's heading. It's quick and easy to operate, and if you want advanced mathematical functions like creating a moving average, they're available within the program itself.

We all know a picture is supposed to be worth a thousand words, but is Trend-Spotter worth $175 to the average businessman? From my viewpoint, there's no question: I'm buying a copy of the program for our business.

(Software Resources, 186 Alewife-Brook Parkway, Cambridge, MA 02138. $175.)

Gregory R. Glau
Prescott, AZ

The Data Reporter

Manipulate your database With this flexible Applesoft package

Users of the Modifiable Database from programmers Robert Clardy and Christopher Anson will know what to expect from Synergistic Software's new release, The Data Reporter. This is a thorough, flexible, comfortable data handling package which provides a satisfactory compromise between simplicity and ease of use.

The Data Reporter is a package of cooperating Applesoft programs. You get The Data Reporter database, of course, plus a Report Generator, an Analyzer/Plotter, a Sort/Merge program and a label-printing utility. There's also a program that modifies the software to meet your special needs, and a user-controlled Reformatter that allows you to restructure your data files without rekeying data. The programs interface with each other and use the same data files, so you can key in data only once and yet have it accessible for multiple uses and separate applications.

The program disk even comes with a utility for converting data files from the company's earlier database system to the new format TDR requires, and the documentation gives technical instructions

for pulling in data files created by other programs. This makes TDR a fairly complete system that provides the usual input, sorting and handling, formatting and printing capabilities, as well as special functions such as manual and automatic updating, form letter merging, and a few unusual functions you won't find in most other programs.

Menus and Prompts

The TDR system is commanded entirely from menus and mini-menus activated by single keystroke commands. Selections from a program's main menu lead to other menus—often with convenient defaults in case you are too lazy, tired or confused to make decisions. The menus and prompts are extensive enough that you almost do not need the manual. And once you've read through the documentation and understand what the program options are, you can operate directly from the on-screen prompts.

The program is safe to play with because it provides good data protection in several ways. The escape key usually aborts a command without data damage and returns you to the main program menu. Data protection also comes from command confirmations and plenty of error-trapping throughout. In most cases, incorrect responses to prompts are no problem. At the worst, hitting the wrong keys will bring you an error report and a fast return to the main menu.

Two Stage Boot

TDR comes on one minifloppy disk, using a protected (noncopyable) version of Apple DOS 3.3. Registered owners of TDR can purchase one backup copy of the program disk by mail from the manufacturer for $5. To run the program you must boot from the master program disk. But once the primary menu has appeared, the system will run from your nonbooting copies.

This primary menu gives you a choice of the Setup program, the Database program, the Report Generator or a demonstration. While the demonstration is valuable for novice users, it seems somehow wrong to have it embedded in the primary menu, which you see every time you boot. Nevertheless, it doesn't interfere. You merely run option 1, 2 or 3, and begin to work.

Application Set Ups

The TDR system is intended to run on your backup copies instead of the master. The idea is that you selectively modify each nonbooting backup into an applications disk to suit your special needs. Each applications disk can be configured only one way at a time. To set it, or reset it, you simply run the Set Up program on the disk. There are dozens of Set Up options, but you can scan them quickly and modify just the ones you want. The rest remain unchanged. Set Up determines, among other factors, the name of your database, printout justification and formatting options and printer control characters.

Another Set Up specification is the data type for each field. Alphanumeric data will not calculate; a numeric or monetary specification is required if you want any mathematical operations on the data. You also set tab stops for printing each field, which become the default or standard format for reports on that database. These standard reports are tabular listings of data where each record forms one row, and each field forms a vertical column at the tab stop you designate. You can also set TDR to add, subtract, multiply or divide any two numeric or monetary columns, and store the result in any third field you specify. This capability is limited, but not severely, in comparison to some other database programs. Other report formats and more elaborate calculations are possible, of course, with the separate Report Generator program.

Set Up allows some interesting features in your databases. Horizontal totalling, for example, adds any number of fields *within* a record, as you enter them, and automatically stores the result in the record's last field. Unfortunately, this last field can't be used with other preset calculations, because no subsequent field exists to receive the results.

You get to pick the one or two fields shown in a quick listing. The normal full listing displays or prints every field one record at a time. But the quick listing gives you a continuous display of just the selected fields, one line per record. This quick list is great for a rapid visual search when your brain blanks out on everything you might use as a formal search key, and is also an easy way to scan through large databases for frequently needed data.

Other Special Functions

All of the decisions you make when you set up a database are changeable, too. You can rerun the Set Up utility any time, and quickly revamp your database as new needs arise. If you select the special reformatting function, the format for each record comes totally under your control. If you wish, you can even generate a totally new database containing only some of the data in the existing file.

TDR has other nice features. It can search, sort, update, calculate and delete on files in memory or on the disk. It will save and load by file number, and append records from the disk into memory (but not the reverse) until there is no more room. Other special functions give you quick totals for each of the numeric and monetary fields in a file and global edit, where you can have the computer replace, add to or multiply the contents of any field in every record.

Database Operations

Once you are satisfied with a database

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setup, you take option 2 from the primary menu: "Run an applications program." The computer then prompts for an applications disk to be inserted, and runs the database program. Data files can be on the applications disk or on a third disk for data only. The database menu gives you options to start a new file, enter records, list/modify, search, sort and output, and also provides disk access, special functions and a catalog-and-quit option.

Starting a new file clears memory and prompts for a file name. If you have nothing in memory, you can skip this option and simply enter records. You can supply a name later when you save the data to disk.

As you key in fresh data, the screen displays up to eight field names at a time, underscores the space you have allotted for each field, and prompts for the next input in sequence. Also, two mini-menus display common operating commands. If your records have more than eight fields, you can scroll to see them all in sequence. TDR supports any standard lowercase hardware adapter and accepts both upper- and lowercase input.

You can edit, delete or print any completed record when displayed. Hit E for edit and a number appears conveniently beside each field. You select fields by number for rekeying or simple math operations. But you have to hit "E" again and again, once for each field you wish to revise. If you hit "D," you can delete one or more records in order from the current record toward the end of the file.

Retrieval Operations

You can look at existing records—on screen or hard copy—two ways: via List/Modify, or more elaborately by doing a search. List/Modify gives you the quick- or full-list options. Records are displayed in order, starting with record #1 or any record number you specify. With a full list, you can edit the records as above. With a quick list, you can scan much more quickly but cannot edit, delete or print any individual record.

Search is a more elaborate function. First you must specify what you want done with all records found in the search; then you must key in some search criteria. Records found in a search can be displayed on the screen; printed using the standard format; totalled, all fields separately; edited (via automatic replacement, addition or multiplication of values); deleted; or saved to a new file. Any combination of these operations is possible.

The search and save sequence, in particular, is useful because it allows you to collect the records you want from existing databases and place them into a new—more homogeneous—file. The new file is faster to work with, and may not need either searching or sorting to be used. Search-and-saves can break down overly long customer lists, for example, by date of last purchase, zip code or any other field, and save each group on separate disks. The program automatically saves the records under the name TEMP, by the way, so to avoid overwriting the new file on a subsequent pass you must load the TEMP file and store it under another name, using disk access commands.

TDR's search capabilities are about average. You can search up to ten fields at a time, within single or multiple files, on one to four drives (or ten volumes of a hard disk). The program will search for alphanumeric matches, numerical ranges or exclusionary matches where the search key is *not* found in the specified field. Searches are neither notably fast nor slow, averaging several seconds per file for each field searched.

TDR's sort capabilities are somewhat similar. You can sort on any one, two or three fields of files in memory or on disk. Sort works normally, except that sorting on numbers requires a field set up to *right* justify its data. Numbers that line up normally, sort normally. But with numbers that line up on the left, the program apparently gets confused and reads the 9 in 90 as being higher than the 1 in 1000. On whichever side you line things up, it's still your responsibility to include the proper number of decimal places, since TDR's justification routine concerns itself with the right-most or left-most *digit*, and not with the decimal point, as it should.

The Output selection from the main database menu provides access to the standard-format print routines, or to various other programs in the system. The standard report can be printed with or without subtotals, and proceeds from any record number you choose to the end of the file. You can even select multiple file operation and obtain an automatic printout of several files right off the disk.

The Report Generator

This program is actually a stand-alone text editor. It operates on numbered lines of text and provides editing, printing and data extraction capabilities. You can run the Report Generator from either the primary menu after the first stage boot or from the database menu by taking the output option.

The program has the usual features of a line-oriented text editor: add, delete, find, get, insert, list, print, save and so on. But it will also allow the construction of "form letter" files with embedded commands that access and print information selected from your databases.

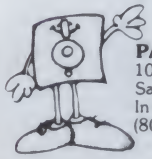
Control-K is the most useful command for creating form letters to integrate text and database information. Various command sequences on lines beginning with control-K tell the computer which record to use for data input, which text line to print next, when to start a new printed

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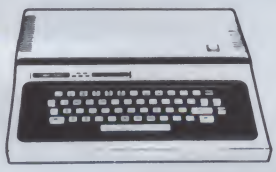
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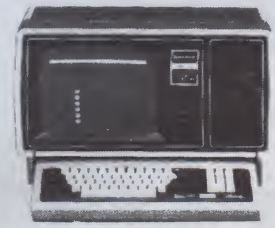
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page, how many times to print a sequence of text, or simply to halt the printing until you hit any key. You use these control-K lines to point the computer at print time to the record you want accessed for merging into the form letter.

Control-F and a field number is read by the computer as a get command at print time. On screen, you will see a "?" followed by an inverse "F" with the field number after it, and an "@" sign for each remaining space in that field. During printout, the computer will retrieve whatever record it has been pointed to, and print data from the specified field at that point in the text.

Control-K also signals a formula definition, or a formula to be processed at print time. Formulas are not printed, but they are calculated at print time and the results are printed in your text. A formula can include any combination of math operations (+, −, *, / and exponents), constants, data drawn from specified fields and formatting commands. You can define up to nine calculations per report, and use them repeatedly in any combination you wish.

Control-R is the signal for "arguments," or arbitrary strings of characters you give the computer at print time and which it then inserts where indicated in your text. The program is delivered set up for zero to ten arguments per report, but you can increase the number via simple and complete instructions in the documentation.

The Analyzer/Plotter

This companion program in the package operates on the designated numeric and monetary fields of one or more data files. It will produce statistical summaries, multiple plots of dot, line or bar charts on the same axes in several colors, and pie charts. It will also save and retrieve the calculations and plots to and from the disk. The graphs will not print with the programs supplied, but the documentation claims that appropriate high-resolution screen dump software for your printer will allow printing of the plots.

Dot graphs are produced simply by plotting the magnitude of two data fields you specify, for all records in the fields you wish to process. Line graphs are produced by grouping the data according to the x-axis values, and then averaging the y-axis values associated with each group. The computer plots a line connecting points that show the average y-value for each x-value group.

Bar graphs are produced by grouping values according to keyword x-value search criteria. Records are sorted into one to ten categories, and the magnitude of the bar indicates *either* the number of records in each category *or* the total of a specified field in the records of each category. Pie charts are produced by the same procedure as bar charts, except that you can display only one at a time and white is the only color available.

Labels and titles can be placed anywhere on the graphic display screen, changed and edited, and then accepted as part of the display. Once graphs have been produced and saved to the disk, you can retrieve and display up to ten of them in any pre-arranged sequence, with single keystroke control.

Loading, Saving

Disk access for graphs or data files is not an automatic function in normal operation. The computer will load and print, or load, sort, and save when it operates on multiple files. But most of the time, you must manually load in files to work on, and save them again before you quit. Except for the first time you save a file, the computer shows you file names by number, nine at a time, and you can load and save with a single keystroke.

Documentation

I found the documentation acceptable, overall. The 6 × 8 inch book has fewer than 100 hefty pages in a loose-leaf padded binder. The writing was generally clear and concise, friendly in some parts but downright murky in other places—

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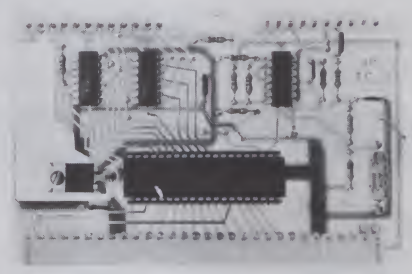
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particularly when discussing the more esoteric functions of the report generator. The whole document is organized logically into functional operations, so finding the section on what you want done is fairly easy, despite the lack of an index.

If the program were not so self-explanatory, this level of documentation would probably be inadequate. But the program is extremely self-documenting, so the book supplied is enough.

The best part of the documentation is the technical section, which outlines the programming lines in the Data Reporter and gives modifications you can key in to make several important changes, including how to search with logical "or" instead of "and" criteria, information on how to load files created by other database programs, how to extend line lengths beyond 132 characters and more.

Conclusions

This is a good program. It is reasonably fast, very comfortable to use, and leaves me with enough control to make it do what I want.

It has limited search and math capabilities, to be sure. But they are capable enough for most uses. Look carefully at these capabilities before you buy, to make sure the program can do all you need it to do. If it meets your technical needs, you'll have a hard time finding a more capable program that is as easy to use as this one.

(Synergistic Software, 5221 120th Ave. S.E., Bellevue, WA 98006. $220; $5 extra for one backup.)

Robert Moskowitz
Canoga Park, CA

Lucidata Pascal

Polybytes converts An SWTP package To Heath's HDOS

The March 1980 issue of *Byte* contained Phil Hughes' review of Lucidata's Pascal for the Southwest Technical Products Corporation (SWTPC) 6800 computer. At the time, I felt this was an excellent piece of software and that something like it was needed for Heath computers. While there are several versions of Pascal available for the H8 and H-89 systems, most are either CP/M-based or have their own unique operating systems like UCSD Pascal. I preferred a version that allowed full use of the features of Heath's disk operating system (HDOS), so I was forced to wait.

The wait is now over, because Larry C. Reeve of Polybytes has converted the package from SWTPC's Flex 2.0 to HDOS 2.0 by writing a new run-time system for the Heath.

Before looking at the features provided, this is a good place to point out the significant advantage of p-code (pseudo-code) machines for language implementations. What Reeve did was make full use of David Gibby's P-6800 Pascal p-code generating compiler, which relies on Nigel Bennee's 6800-based run-time system, and write his own run-time package (RTP) for the computer of his choice. This has been the main idea behind the p-code concept from the beginning, but thus far, only the UCSD Pascal versions have made much use of it. Reeve was able to go one step further: he wrote run-time systems in both 8080 and Z-80 code, allowing total compatibility between the H-89 with its Z-80 and the older H8 with its 8080. The former can use the slightly faster Z-80 RTP, while the latter can run the same programs using the 8080 RTP. It's an excellent approach, and one that will prevent the Pascal package from becoming dated as 8080 users upgrade to Z-80 processors.

Lucidata Pascal is a subset of the ISO Standard Pascal, with certain input/output enhancements added to make practical programming easier and, in this case, to make fullest use of the capabilities of

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HDOS. Two data types, REAL and RECORD, are omitted. Perhaps if I had used them elsewhere I might feel the loss, but after several months' use I can't say that I've missed them. The Type directive only supports enumerated types, but an outport procedure has been added, letting you assign a byte value to an 8080 or Z-80 I/O port. Also added is support for binary constants in the source code.

Procedures, functions, multi-dimensioned arrays, recursion and file types are all available. All the branching constructs are present, including IF-THEN-ELSE and CASE-OF. REPEAT-UNTIL and WHILE-DO are present, as are the data types CHAR, BOOLEAN, INTEGER, BYTE and ALFA (a six-character string), and scalars, which can be members of SETS. In general, little of significance is left out.

Lucidata Pascal provides the standard I/O procedures of RESET, REWRITE, READ, WRITE, POSITION, READLN and WRITELN. POKE, PEEK and HALT are available, and the programmer can define USER functions to pass control from a compiled Pascal program to the user code. The normal ordinal and predicate functions CHR, ORD, SUCC, PRED, ODD, EOLN and EOF are provided, as are CARD, UNPACK, INPORT and OUTPORT. The standard arithmetic and transfer functions such as ABS, SQR, TRUNC and ROUND are also included.

A useful feature, present in the original 6800 version and retained in the HDOS version, is the use of automatic paging of the p-code file into memory for those systems having less than 56K bytes of memory. The way the run-time package is written, a 48K or smaller H8 or H-89 will always use the paging feature, but in my 56K H8 I have yet to see this used. In other words, the owner of an unexpanded H-89 can compile and run programs with a p-code size of 32,768 bytes.

The manual that accompanies the 5¼-inch diskette is exemplary. The only thing it lacks is an index, but the table of contents is laid out well enough so that it poses no real problem. Everything is arranged in a logical manner, and most of the manual is devoted to a detailed description of what each element does and a sample of how each is used. The entire manual, including five appendices, is about 75 pages, and includes syntax diagrams, a description of the resource use, a section on fine-tuning programs and a section on customizing the run-time package. This last makes use of a well-designed patch utility that allows the use of non-HDOS device drivers. The method of altering stack size and memory limits is also covered.

Included on the diskette with the Pascal compiler, the 8080 run-time package and the Z-80 run-time package is a set of 14 demonstration programs that I found invaluable as an introduction to this version of Pascal. The programs, ranging from a sample of the use of Alfa to a demonstration of Usercode, are invaluable as learning tools and an introduction to the spirit and function of Pascal. There are a few sample programs that just show programming technique, like the eight queens problem and a demonstration of sorting routines. These demo programs are ready to compile and run, and include a Validate routine to test the compiler and run-time package as soon as you start the system.

One of the appendices is a list of references and additional readings on Pascal, including Jensen and Wirth's standard reference and Peter Grogono's excellent text. I'd like to add one to the list that I've had good results with—*Pascal Programming Structures* by George W. Cherry. Cherry gives the most lucid explanation of data structures I've seen, and his text is applicable to any version of Pascal. His and Grogono's books are likely to be the only two reference texts you'll ever need for Pascal, regardless of what version you choose.

Without doubt, one of the most valuable features of Lucidata Pascal is the exceptional support Larry Reeve himself provides. Being located in Iowa, as opposed to the Netherlands (the original source of Lucidata Pascal), certainly helps where mail is concerned. Larry answers inquiries with a total turnaround time of about a week. He also provides updates of the software for a truly minimal cost; the update I just received rectified a run-time problem that I hadn't encountered, and added two functions, Inport and Outport. Total cost is $2.50, including about six pages of new documentation. Total time is about a week. Other vendors please note: This is how software support is supposed to work!

Reeve also makes available a modified version that incorporates special commands for handling the Heath HA8-3 color graphics board, and these modifications make Lucidata Pascal nearly the perfect graphics language, quick and easy to write, fast-running and fully documented.

What you receive for your money is the p-code compiler, the two run-time packages, source code on the disk for 14 demonstration programs and a validation routine, full documentation, and first-rate support with fast delivery and response to questions. And the best news is the price. Where the original P-6800 Pascal cost $150, Larry's Lucidata P-8080/Z-80 Pascal package costs $95 for the plain version, and $30 extra for the graphics package. And that's for one. If you line up four other Pascal enthusiasts, the group purchase price is $65 each, a truly remarkable value.

(Polybytes, 325 19th St. S.W., Cedar Rapids, IA 52403.)

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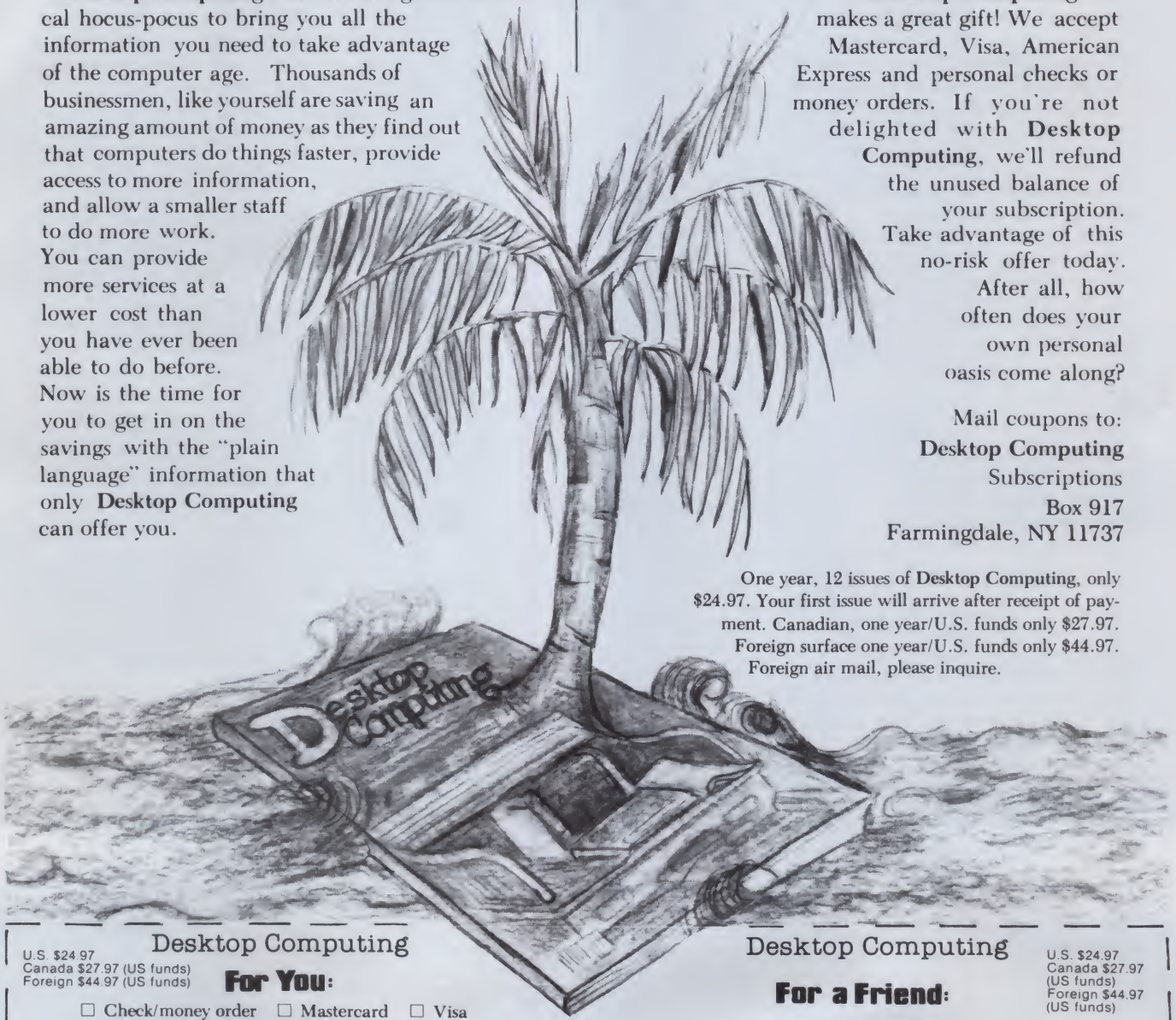
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The TRS-80 Models I and III are very practical and flexible machines. A whole industry has sprung up which customizes TRS-80 systems. Dealers offer many different options that provide alternatives to the straight factory showroom model. They also offer accessories and peripherals with different prices and combinations other than those found in the Radio Shack catalog. Perhaps the most common customizations done by TRS-80 owners are the insertion of memory chips from many sources and the addition of disk drives from several suppliers. It is possible to beat the Radio Shack prices by ordering from suppliers who advertise in *Microcomputing* and *80 Microcomputing*, but the integration and the maintenance of these customized systems is often up to you.

Apparat, in Denver, CO, is one company that has traditionally specialized in upgrading and customizing TRS-80 systems at a reasonable price. They needed a diagnostic tool that would help them evaluate the systems that came to them with a sometimes very mixed assemblage of disk drives, controller boards, memory chips and peripherals. They worked closely with a software author named Dave Stambaugh to develop a program called Floppy Doctor. Now, they are cooperating with Stambaugh to make the program generally available.

If you have a TRS-80 system with mixed accessories, or if you have a standard showroom model that you want to make sure is running up to snuff, the Floppy Doctor could be a very cheap investment that pays high returns.

The Floppy Doctor is a stand-alone package. It doesn't need TRSDOS or any other operating system to run. It has its own bootstrap loader and it will run on any TRS-80 disk drive, regardless of density, number of tracks or number of sides. It requires a system with a minimum of 32K of RAM. The disk cannot be duplicated by normal means. It can only be copied by careful use of Apparat's Superzap program.

What Does It Do?

The Floppy Doctor disk actually contains two programs: a memory diagnostic and a very thorough disk drive tester. Most memory test programs (and many are available) perform a simple read/write test. They enter data in and then read it back out while checking for accuracy. These tests will certainly discover a chip that is blown or improperly inserted, but they may pass chips that are running on the ragged edge of their specifications. (Some "bargain" memory chips are no bargain!) These same chips may cause mysterious errors when the system is executing many different commands in different sequences.

The Floppy Doctor read/write test tries every possible data pattern in every memory address 520 times. Additionally, it is accompanied by a unique M-1 Worm Test. This test is named for the Z-80 M-1 machine state (op code fetch), which is the most critical in terms of memory timing, and for the fact that it "worms" its way through the system's memory.

The M-1 Worm Test causes the computer to execute a block of code. This code moves itself around in the memory as it executes over and over. Proper execution of the test requires fast response and coordination between the memory pages and the CPU. It takes about 30 minutes to run one complete cycle of the M-1 Worm Test in a 48K machine, but if you're really interested in proving that a system will operate under conditions of heavy use, it would be best to run the test at least overnight. The performance of integrated circuits can change greatly when heat builds up over many hours of use.

The Floppy Doctor memory diagnostics are as easy to use as they are effective. You essentially turn them on and go away. You decide if the system should pause when it encounters an error or simply keep track of any errors it finds and display the condition and location on the screen.

Testing the Disk Drives

The Floppy Doctor disk drive checks are even more complex than the memory tests. Because of the mechanical devices involved, the program sometimes needs some help from human hands. Ten different routines are available for disk drive testing.

These are not simply different combinations of the same read/write cycle. Each routine is a unique exercise which really puts a disk drive through its paces. The drive tests can be chained so they execute consecutively.

They proceed in a logical order. The first test checks the functions of the controller board and the mechanical operation of the drive or drives under test. The second test checks the transfer of the data between the drive and the controller. The third test checks the drive's ability to seek all of the track positions on 35-, 40-, 77-, or 80-track drives.

The next four tests perform various data entry and retrieval functions to check for cross-track interference, head positioning, head electrical condition and many other factors. These tests also check for compatibility between disk drives. A drive that works well by itself may not be aligned to the common standard. It is not at all unusual for a disk recorded on one drive to be unreadable on another. This condition has become well-known to users of magnetic tape cassettes. Many cassette users have to adjust head positioning when reading tapes made on different recorders. Disk-drive users have been spoiled by the close tolerances used in disk-drive quality control checks, but misaligned drives can cause many mysterious program errors.

The ninth disk drive test on the Floppy Doctor menu examines the accuracy of the drive motor speed. The tenth test is essentially a drive exerciser, which is invaluable to a technician working on the drive system.

All of the Floppy Doctor programs provide on-screen reports about what they are doing. They describe the checks being run and the locations being tested. Over 22 error messages describe problems that the various tests may have encountered. The error messages are in real English and not in secret code numbers. The most common error messages are explained more fully in the instruction book.

The Floppy Doctor instruction book is not fancy, but the 16 single-spaced pages provide a great deal of information. An index would have been helpful, but most users of the programs will run them in sequence and that's the way they are described in the manual.

The Floppy Doctor is a diagnostic tool that could be more valuable to the computer hardware hacker than a volt/ohm meter. But like all test equipment, it must be used correctly if it is to give the correct indication. Improper setup of the computer (no disks in the drives and so on) can result in error messages that are not correct.

But properly used, it is a valuable tool. Its ability to isolate and diagnose problems certainly would pay for itself quickly in reduced maintenance time and time avoided trying to track down mysterious software glitches that are really the result of intermittent hardware problems. Just like a real doctor, a visit with the Floppy Doctor can be good for both healthy and sick systems, but this one makes house calls!

(Apparat, 4401 S. Tamarac Parkway, Denver, CO 80237. $29.95.)

Frank J. Derfler, Jr. Herndon, VA

Floppy Doctor Error Messages

The first four errors are the most commonly found. They are explained in detail in the Floppy Doctor operating manual:

- CRC Error
- Lost Data Error
- Record Not Found
- Seek Error

The following errors are less common, but they are all reported by Floppy Doctor:

- Index Mark Not Sensed
- Index Mark Sensed When Not Expected
- Track 0 Not Sensed Correctly

- Busy Flag Not Sensed When Expected
- Drive Exceeded Time Limit To Complete Operation
- Controller Chip Track Reg. Is Not Being Updated
- Write Protect Not Sensed When Expected
- Write Protect Sensed When Not Expected
- Drive Sensed Not Ready
- Drive Sensed Ready When Not Selected
- Forced Lost Data Error Did Not Occur When Expected
- Forced RCD Not Fnd Error Did Not Occur When Expected
- Controller Does Not Sense Any Data Coming From Drive
- Controller Did Not Issue End-Of-Operation Interrupt
- Controller Did Not Issue Motor Time-Out Interrupt
- Controller Wait State Counter Not Working Correctly
- Unexpected Motor Timeout Interrupt
- Data Read From Disk Is Incorrect

SuperScribe II

Do your Apple II Word processing without An 80-column board

One of the problems I've encountered using the Apple II for text editing is its 40-column display. I could buy an 80-column board, but it would cost me between $300 and $350, and wouldn't have the resolution I need for an acceptable display on my 9-inch monitor.

But then I found the word processor SuperScribe II, which eliminates the need for an 80-column board. It is unique because it allows viewing of 70 columns using a graphically created 70-column character set.

The 70-column character set is acceptable for viewing a whole line at a time, but it is compressed, and may be a strain to read for long periods. You can enter your text using the 40-column format and then later view the text in the 70-column format. In this way, you can check what the text will look like before you print it.

A second, but important, feature is that since the characters are generated using software, you don't need a lowercase kit. This will save you an additional $60. That's not bad: a total of about $400 savings.

Operation

To simplify a complicated learning process (I find that it takes several hours to learn most of the sophisticated text editors), the SuperScribe reference manual begins with an 11-lesson tutorial on using the system (the manual is 153 pages in a nice ring binder, and includes a command reference card).

The text editor uses an extensive menu system for operation. The main menu gives you three options: editor, runoff and end.

Before you go on the editor, you must initialize a data disk. It's important to have one or two initialized disks on hand and one in your drive because you don't have to save your own files manually: SuperScribe does it for you automatically.

Once you've created a few data disks, you reboot the editor by entering PR#6, and go into the editor. When the program comes up, it asks you the file name for the document you will be working on. After you've entered that file name, the editor asks you if it's OK to create. You answer Y for YES if it is a new file. Then the editor lets you input a previously-stored file. Then a split screen view is displayed, with the top portion of the screen the work area and the bottom four lines the command area.

The command area displays the tab stops, the output file name (which text data is sent to), the input file name (if you took data off the disk), a number representing the amount of work space left on the disk and a blinking cursor next to the word COMMAND:. Here you may change the number of characters displayed on the screen. Entering 70c will give you the 70-column format, and entering 40c will get you back to 40 columns. Entering a c will move the cursor from the command area to the top of the work area. Here you can begin entering your text. The options include embedded commands for special output formats. For example if .NP is entered into the text on a separate line, a new page will be started. It also has commands for right and left justification. You can merge text with other files, and insert letters, words, sentences or even whole paragraphs. You can also move lines or paragraphs into a buffer, to be placed elsewhere in the text.

Runoff

Runoff is the module that formats and prints your files. It can be entered after the system is booted, or while in the editor.

Before you use Runoff, you can configure the options that it offers. It also requests your printer specifications so it can output to your printer in the correct format. Runoff has several options to aid you in printing your documents, including printing text on the screen before it is sent to the printer, sending the text to your printer and monitor at the same time, printing one page at a time, or printing all of your file at once, and printing several files one after another (called spooling).

Other Features

Some of the other features in SuperScribe II not found in most word processors include printer spooling with no hardware (print several files, one after another), built-in form letter and mailing label capabilities, a true keyboard buffer, a complete search-and-replace editing feature and DOS commands accessibility. It also allows hyphenation and full macro capabilities. And a last feature is the ability to handle documents larger than the computer's memory.

SuperScribe II is a unique word processor for what it offers, and, especially, the 70-column graphics display capability—upper- and lowercase, without hardware. I recommend it.

(On-Line Systems, 3675 Mudge Ranch Road, Coarsegold, CA 93614. $124.95.)

Howard Berenbon
Southfield, MI

Hebrew II

Innovative programming Lets you write in Hebrew On your Apple II micro

Most of you probably don't have a special interest in Hebrew. Read on anyway. Hebrew II is an example of what modern desktop computers can do when combined with innovative programming.

Hebrew is the oldest language used today. It is the spoken and living language of Israel, and is used, virtually unchanged, in Jewish prayers. The written language has 23 consonants, including two which are silent. Five of the 23 have a separate form when used at the end of a word. In common usage, vowels are neither needed nor used. However, they are very important for anyone wanting to learn the language.

Unlike English, written Hebrew is completely phonetic. This fact makes spelling and reading easy. Most Americans, like myself, need vowels to read properly. These are generally written underneath the consonants as dots and dashes. A few show up in other places in the text. An experienced reader of Hebrew reads fluently without the vowel printings.

In Hebrew II, the alphabet is arranged on the Apple keyboard in the same order as on an IBM Selectric, to help those fluent in Hebrew to touch-type. A printout of the alphabet, including vowels, numerals and available symbols, is shown in Table 1. The Kiddush in Sample 1, a Friday night blessing, shows how a document prints out in Hebrew. Sample 2 shows the first sentence of this prayer with vowels, and a few examples of Hebrew words.

It is interesting to note that vowels are entered into the text using the escape key. Hebrew uses only uppercase letters. Logically, the escape key, used normally for uppercase letters, is here used for the vowels.

The documentation is brief and to the point. There are only seven pages to the manual, but that's all you need. The style of the documentation is amusing and

friendly. You are invited to phone Aurora any time you have a problem with the program, but not for help with grammar. (Hebrew grammar is a mystery to most Americans.) Perhaps some examples of the vowels with consonants would help. I had to experiment quite a bit to find the correct combinations.

After glancing at the instructions for a few minutes, I promptly booted the DOS 3.3 disk to see what it would do and how the screen would look.

It's strange to see the cursor at the right upper corner, but that is, of course, where it belongs. Push any key of the alphabet and Hebrew characters appear right to left on your screen. Everything works just like any other word processor. Words are separated by a space and/or punctuation. If the whole word at the end of a line does not fit, it is not cut up, but automatically moved to the next line.

Numerals and their decimal points are printed left to right on the screen, as is customary in Israel, and is required by international commerce. If you want to insert numbers in the text, simply start after a space, and the computer prints in the left to right mode so that the numbers appear in proper order. For example, the sentence "The house is 20.5 meters long" looks like this:

ארך הבת 20.5 אמה

There is no use guessing what Hebrew letter you are going to get. Only one key is the same. The R key gives you the Hebrew equivalent, a resh.

On the program disk are two sample files, one of which is called *Character Set*. It is just that (see Table 1). The other file is formatted to print address labels.

Left and right arrows as well as control characters move the cursor around without affecting the text. You can print 13 lines of 39 columns each. This will fill the screen, and you are then prompted to (S)ave, (P)rint, (B)oth, (G)o back or (C)lear the screen. The program is configured for the Silentype printer only. Naturally, you need a graphics-equipped printer for Hebrew. For this review I saved each screen, and then printed it on a graphics-equipped Epson MX-80 dot matrix printer with a screen dump program.

If you are fluent in Hebrew, you are ready to type. Otherwise, the system is a very good learning tool.

Editing is limited to deleting a character at a time by bringing the cursor to the place where you want to change something, and using the space bar to rub out letters. Then you type over the empty spaces. If you want to insert very much you are in trouble.

Usually when printing in Hebrew, some letters occupy a full space, smaller letters half a space. With the Hebrew II word processor, each character occupies the same space horizontally. This takes some getting used to.

I would suggest one additional feature as a future update: an insert mode is required.

Included in the word processing package is a set of self-sticking Hebrew consonants. I cut them out and stuck them on the front of the appropriate keys. Presto, you now have a Hebrew word processor. Labels for the vowels are not yet available. You have to make your own and stick them on the keys with tape.

The shortcomings of Hebrew II must be considered in the light of the commercial facts of life. The market for this kind of software is obviously small. This limits the effort that can be put into developing the program.

(Aurora Systems, Inc., 2040 E. Washington Ave., Madison, WI 53704. $60.)

G. R. Brieger
Redmond, WA

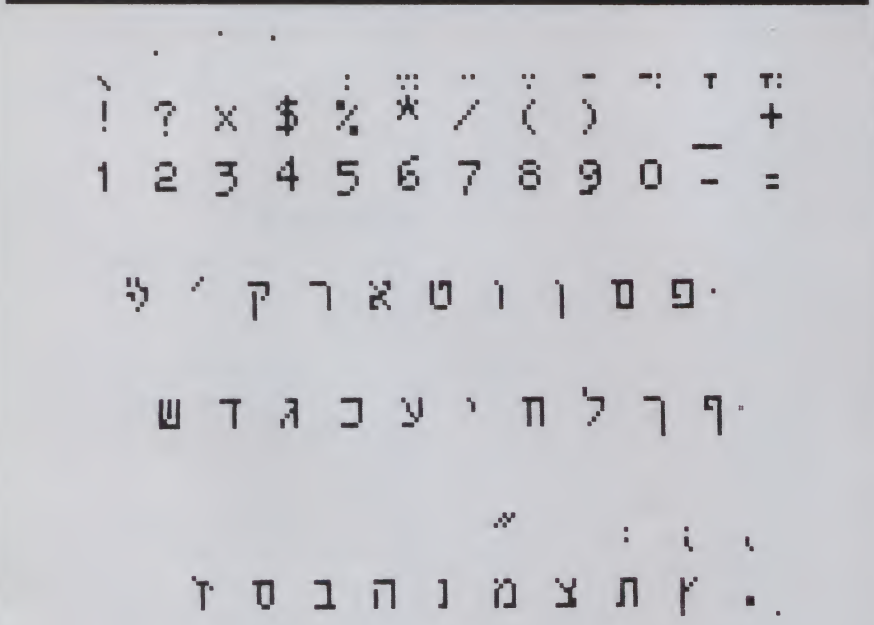


Table 1.

The Kiddush

ברוך אתה יי אלהינו מלך העולם בורא פרי
הגפן: ברוך אתה יי אלהינו מלך העולם.
אשר קדשנו במצותיו ורצה בנו. ושבת קדשו
באהבה וברצון הנחילנו זכרון למעשה
בראשית.כי הוא יום תחלה למקראי קדש זכר
ליציאת מצרים כי בנו בחרת ואותנו קדשת
מכל׳העמים ושבת קדשך באהבה וברצון
הנחלתנו. ברוך אתה יי מקדש השבת:

Sample 1.

בָּרוּךְ אַתָּה יְיָ אֱלֹהֵינוּ מֶלֶךְ הָעוֹלָם.

Ramat Gan (a village in Israel) on(al) poison(ra'al)

רַמַּת גַּן עַל רַעַל

Sample 2.

CALENDAR

Eighty/Apple Computer Show

The Eighty/Apple Computer Show will be held at the NY Statler Hotel in New York City April 2 through 4. This second annual show will include over 100 commercial exhibits of hardware, software, printers, books, magazines and accessories for these two popular small computer systems. Other systems such as IBM, Sinclair and Atari will also be featured by many exhibitors.

For additional information contact: Kengore Corporation, 3001 Rte. 27, Franklin Park, NJ 08823. 201-297-2526.

California Computer Show

The California Computer Show, a single source, one-day computer show for OEMs, sophisticated end users, dealers and distributors will be held April 22 from 1–7 PM at the Hyatt Hotel, 4290 El Camino Real, Palo Alto, CA 94306.

For additional information contact Carol Reimer, c/o Norm De Nardi Enterprises, 289 S. San Antonio Rd., #204, Los Altos, CA 94022. 415-941-8440.

Computer Show and Office Equipment Expositions

The New York Computer Show and Office Equipment Exposition will be held at the Nassau Coliseum in Uniondale, NY, April 22–25 from 10 AM to 6 PM.

The second annual Southwest Computer Show and Office Equipment Exposition will be held in Market Hall at the Dallas Market Center in Dallas, TX, April 15 to 18. Show hours are 10 AM to 6 PM daily.

The Southern California Computer Show and Office Equipment Exposition will be held at the Los Angeles Convention Center May 6 to 9 from 10 AM to 6 PM daily.

Admission for each show is $5 for adults and $3 for children.

For further information contact National Computer Shows, 824 Boylston St., Chestnut Hill, MA 02167. 617-739-2000.

National Computer Conference

The National Computer Conference will be held June 7–10 at the Astrodomain, Houston, TX.

Registration must be received by May 3. To register write to NCC '82 Registration, AFIPS PO Box 9658, Arlington, VA 22209. For further information call 703-558-3608.

Moving Microcomputers into the Mainstream of Education

The workshop, Moving Microcomputers into the Mainstream of Education, will be held at the University of Victoria, Victoria, B.C., May 6–8.

For more information contact the University Extension Conference Office, University of Victoria, Victoria, B.C. V8W 2Y2. 604-721-8475.

Applefest/Boston

The second Applefest/Boston will be held May 14 to 16 at Hynes Auditorium, Boston, MA. Show hours are 11 AM to 6 PM daily. The show will have over 200 displays and booths, plus seminars and panel discussions. Ticket prices are $6 per day or $15 for a three-day ticket.

Call or write National Computer Shows, 824 Boylston St., Chestnut Hill, MA 02167. 617-739-2000.

Computerfest '82

The Midwest Affiliation of Computer Clubs is sponsoring the seventh annual Computerfest, June 18–20 at Franklin University, Columbus, OH. Computerfest will include lectures, demonstrations, exhibitions and a flea market.

For more information contact M.A.C.C., c/o Professor Don Moore, 201 South Grant Ave., Columbus, OH 43215.

NJ Microcomputer Show and Flea Market

The third annual NJ Microcomputer Show and Flea Market will be held May 22 at the Holiday Inn (North) at the North Terminal of Newark International Airport, Newark, NJ. The event will include over 50 commercial exhibitors and 150 flea market sellers. Hardware, software and accessories for all popular systems, including Apple, TRS-80, Atari, PET, Heath/Zenith, ZX-80/81, S-100 and IBM will be for sale.

For additional information contact: Kengore Corp., 3001 Rte. 27, Franklin Park, NJ 08823. (201)-297-2526.

Videotex '82

The Videotex '82 Conference will be held June 28–30 at the New York Hilton, New York City.

For information contact Online Conferences Ltd., Argyle House, Northwood Hills, HA6 1TS, Middlesex, England, United Kingdom. Northwood phone: (09274) 28211; international phone: 44-9274 28211; Telex: 923498; cable: Online Northwood.

National Computer Camp

National Computer Camp will be held in Simsbury, CT from July 11–Aug. 16 for youngsters ages ten to 18. In addition to learning about computers, children will have an opportunity to enjoy recreational activities including swimming and tennis.

For more information contact Michael Zabinski, Ph.D., National Computer Camp, PO Box 624, Orange, CT 06477. 203-795-3049.

CLASSIFIEDS

Classified advertisements are intended for use by persons desiring to buy, sell or trade used computer equipment. No commercial ads are accepted.

Two sizes of ads are available. The $5 box allows up to 5 lines of about 35 characters per line, including spaces and punctuation. The $10 box allows up to 10 lines. Minimize *use of capital letters* to save space. No special layouts allowed. Payment is required in advance with ad copy. We cannot bill or accept credit.

Advertising text and payment must reach us 60 days in advance of publication (i.e., copy for March issue, mailed in February, must be here by Jan. 1). The publisher reserves the right to refuse questionable or inapplicable advertisements. Mail copy with payment to: **Classifieds, *Microcomputing*, Peterborough, NH 03458.** Do not include any other material with your ad as it may be delayed.

For sale: SWTP chassis w/power supply, MP-M2, MP-S, MP-8M boards, $125. Call John, 408-262-3101.

Cromemco S-100 computer boards, brand new. Z80SCC, 32K RAM, cardcage, disk cont., PROM Basic, much software. All p.c.b. to make system 2D. Also Heath H-19 and Gimix 6800 business system. 32K RAM, four disk system, lots of software. This is a full business system, ready to go. Over 10K invested. 1st offer over $4000 takes Gimix. 1st $2000 takes Cromemco. Phone 313-349-5513 after 8 PM.

Wanted: Ohio Scientific 300, 400, 420C, 440B, 510, 525, 527, 560Z or other boards. Literature, catalogs, ap. notes, and cabinet needed. Edward H. Carlson, 3872 Raleigh Dr., Okemos, MI 48864. 517-349-1219.

SWTP 6800, 32K, 2 disk drives, Smartbug, 2 MPS, music software. Looks like Chieftain. $1500. 214-352-9568.

An Apple Graphing Program
The Data Reporter
Pascal for the Heath
A TRS-80 Diagnostic
Word Processing in Hebrew

Trend-Spotter

A remarkable program Generates Apple graphics With the touch of a key

Late at night, the businessman sits at his cluttered desk, poring over sheets and sheets of paper, printouts filled with little numbers for SALES and OVERHEAD and INVENTORY and GROSS PROFIT and CASH FLOW and UTILITY COSTS and on and on and on.

He tries to compare last year's data with current information. One month is down, another is close to the same, and another is higher this year than last.

He works his way through four cups of coffee and three pages of printouts before he throws down his pencil. "Darn!" he mutters to himself. "My Apple is great for keeping track of all this stuff, but for me to sit here and try to make sense out of all this information . . . well, it's just impossible!"

No longer, though, thanks to a remarkable program called Trend-Spotter, put out by Software Resources, Inc.

This $175 program contains two parts —the Database section, where you save your own information, and the Display part, which is the graphics section of the program. What it does is take your data and transform all those numbers into a readable graph. If you have the Apple Silentype printer, it'll give you a hard copy, too.

Even with a black and white monitor, the displays are terrific. Using colors, with a good monitor, you have to see them to appreciate them.

Well, Trend-Spotter can do all they claim it can, and even more.

Perhaps the best thing about this program is how easily it works and how simple it is to run, and yet what complex functions it's capable of, if you need them.

Just about anyone with a bit of programming knowledge can set up a simple high-resolution graphing program. But Trend-Spotter takes things so much farther.

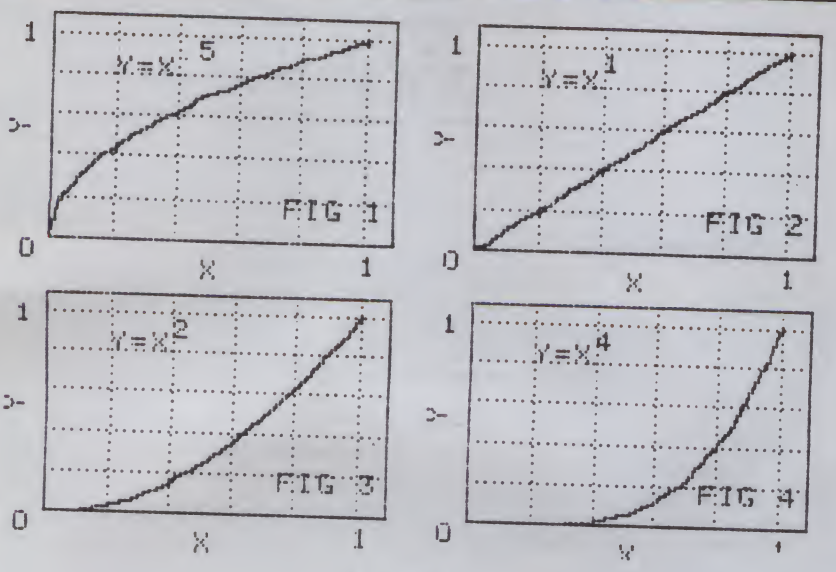
Everyone knows what a bar graph looks like—thick columns going straight up.

Trend-Spotter can handle that easily, of course, but it's also got a couple of aces up its sleeve. For instance, you're able to bar graph one data set, and then put another graph *on top*, even using black as a color to 'erase' part of the first graph, to get a perfect overlay effect. Or say you'd like to bar graph two sets of data. Trend-Spotter provides an LBar (leftbar) and RBar (rightbar) command so you can have two side-by-side bar graphs, each in its own color.

I've done a lot of my own graphics at our business to compare yearly sales, material costs and so on, and so I was a little skeptical when I started reading the Trend-Spotter manual. After all, they claimed they could do a number of different graphs, even on the same screen—scatter graphs (little cross marks), line graphs (which will connect those cross marks), bar graphs (up and down thick lines) and area graphs (like a line graph but with the whole area below the line all filled in). Then they claimed they could put things like a *trend line* into the picture—showing which general direction the data was heading. (Sales up or down this year? Which *way* are they going?) They claimed they could *smooth* out the graph display, using a mathematical formula. They could display the *moving average* of the data. They even said they could combine files and display the new total. (Want to know what your entire utility costs were last year?—Trend-Spotter will add up your data for electricity, gas, water, etc. and display a new graph as a combined total.)

To give you more flexibility, Trend-

(continued on p. 198)



Sample 1.

Reader Service for facing page ↙26→

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The most comprehensive Apple Catalog ever offered. Over 200 pages of Apple Computer Systems, Displays/Monitors, Printers, Software, PC Cards, Games, Books and Accessories! Proven products carefully selected for their quality and cost effectiveness by the Apple experts at Computer Town. To get your catalog send $9.95 refundable with your first order, to Computer Town today.



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REMEMBER:



MORE THAN JUST ANOTHER PRETTY FACE.

Says who? Says ANSI.

Specifically, subcommittee X3B8 of the American National Standards Institute (ANSI) says so. The fact is all Elephant™ floppies meet or exceed the specs required to meet or exceed all their standards.

But just who is "subcommittee X3B8" to issue such pronouncements?

They're a group of people representing a large, well-balanced cross section of disciplines—from academia, government agencies, and the computer industry. People from places like IBM, Hewlett-Packard, 3M, Lawrence Livermore Labs, The U.S. Department of Defense, Honeywell and The Association of Computer Programmers and Analysts. In short, it's a bunch of high-caliber nitpickers whose mission, it seems, in order to make better disks for consumers, is also to make life miserable for everyone in the disk-making business.

How? By gathering together periodically (often, one suspects, under the full moon) to concoct more and more rules to increase the quality of flexible disks. Their most recent rule book runs over 20 single-spaced pages—listing, and insisting upon—hundreds upon hundreds of standards a disk must meet in order to be blessed by ANSI. (And thereby be taken seriously by people who take disks seriously.)

In fact, if you'd like a copy of this formidable document, for free, just let us know and we'll send you one. Because once you know what it takes to make an Elephant for ANSI . . .

We think you'll want us to make some Elephants for you.

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